OFFICIAL PUBLICATION OF THE PROCEEDINGS AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

VOLUME 44, NO. 12
JUNE 6, 1955

AMERICAN

DYESTUFF REPORTER

Devoted to Textile Chemistry
BLEACHING • DYEING • PRINTING • FINISHING

COLORS

that keep their bloom season after season

A perennial favorite is washable leisure wear, in an array of bright colors. But consumers expect these garments to be able to take lots of hard wear, sun and suds — without losing their color and fresh appearance.

Washable rayons and cottons dyed with uniform Du Pont vat dyes are sure to give exactly this kind of outstanding color performance.

Our technicians are always glad to help you in the proper choice and application of these superior vat colors; or to help you with any dyeing problems. Write to: E. I. du Pont de Nemours & Co. (Inc.), Dyes and Chemicals Division, Wilmington 98, Del.

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DU PONT

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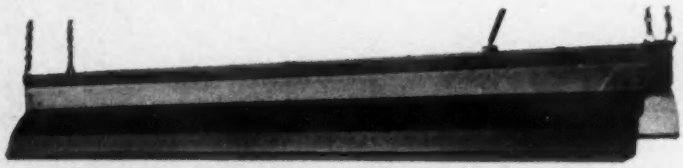
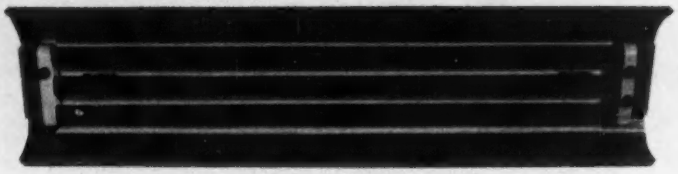
. . . THROUGH CHEMISTRY

Check potential dye streaks at the SOURCE

with the new IDENTA-LITE*

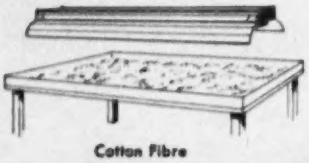


Special high-intensity reflector finish

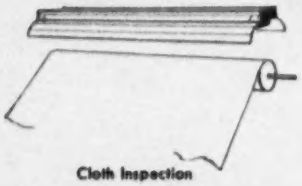


3—48" ultra-violet lamps

Immaturity
Cat-eye Cotton
California Cotton
Fibre Contamination
Oil Spots



Cotton Fibre



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Excellent for dyestuff and chemical identification and adulteration

The powerful ultra-violet rays of the Identa-Lite instantly show up almost all of the potential causes of dye streaks . . . from the bale to cloth inspection. Various defects produce characteristic reactions under this light, thus making it easy to correct each at its source.

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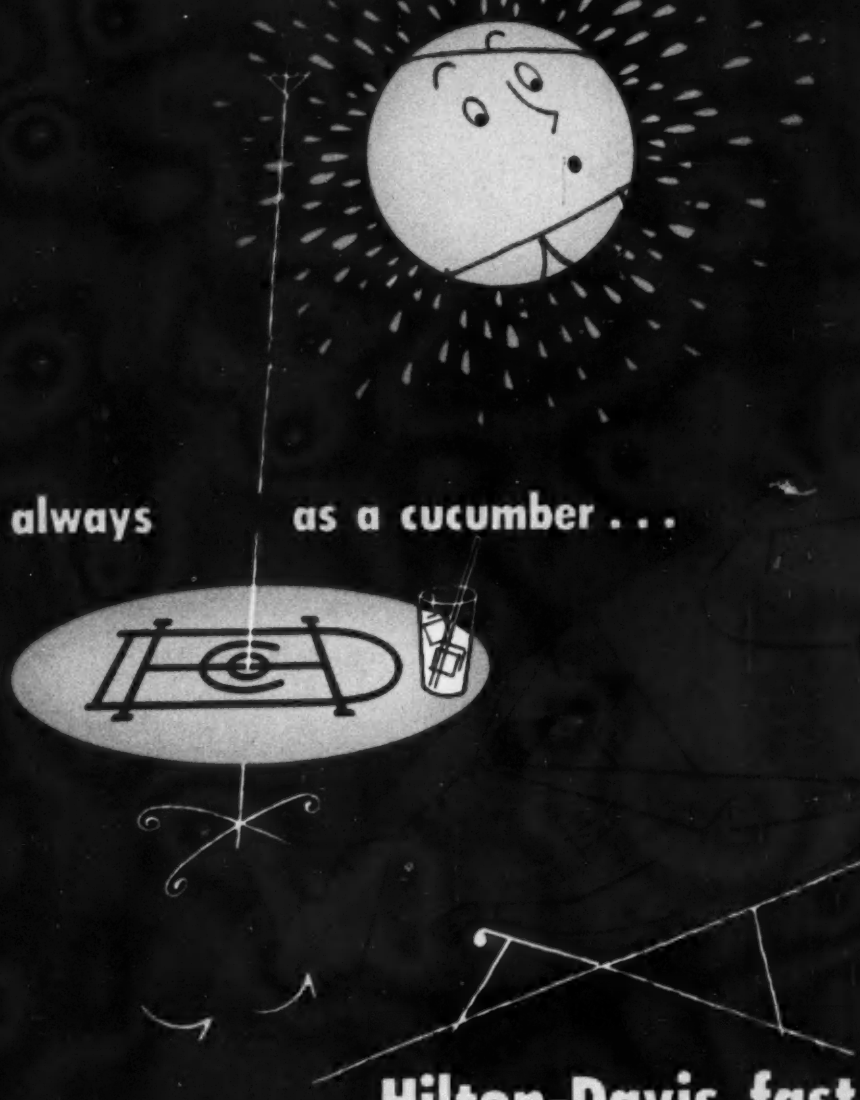

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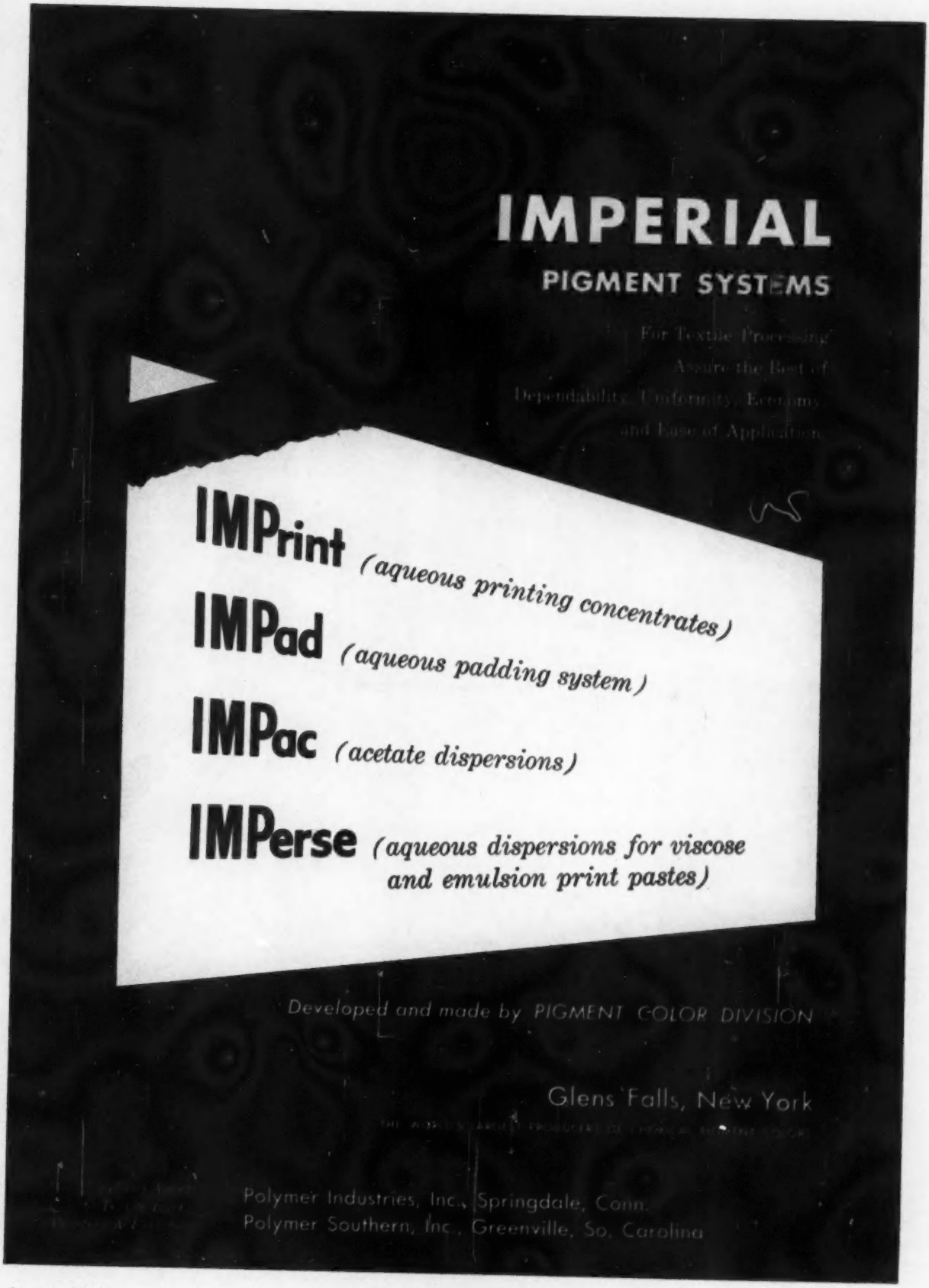
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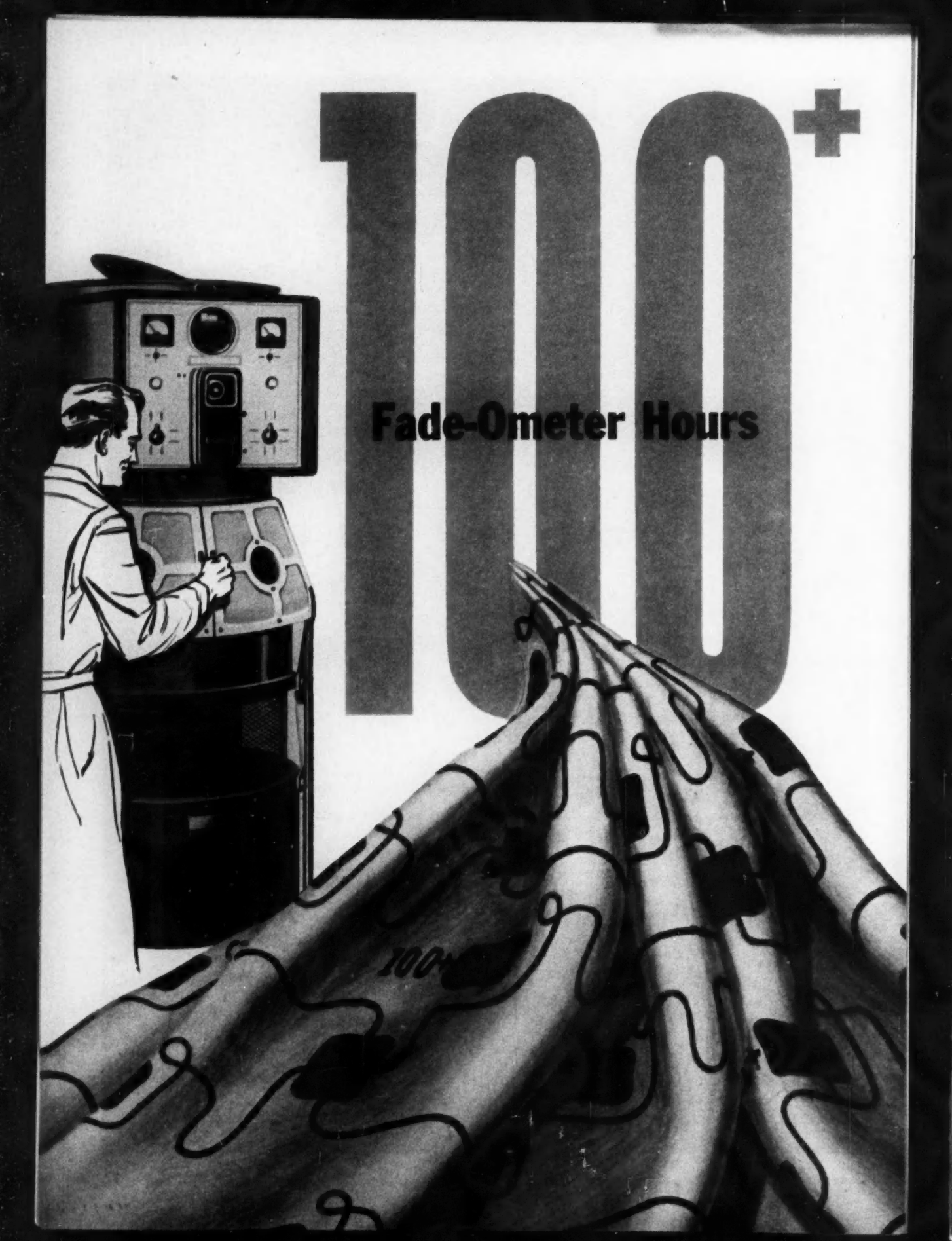
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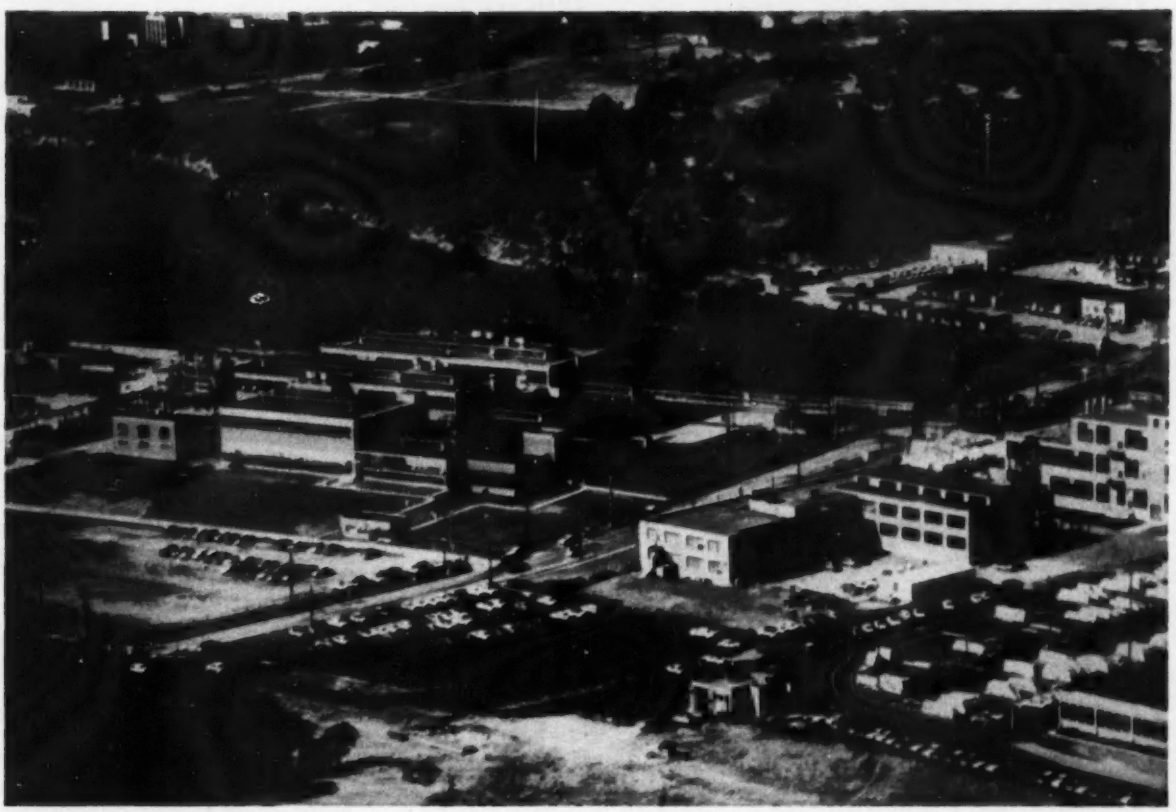

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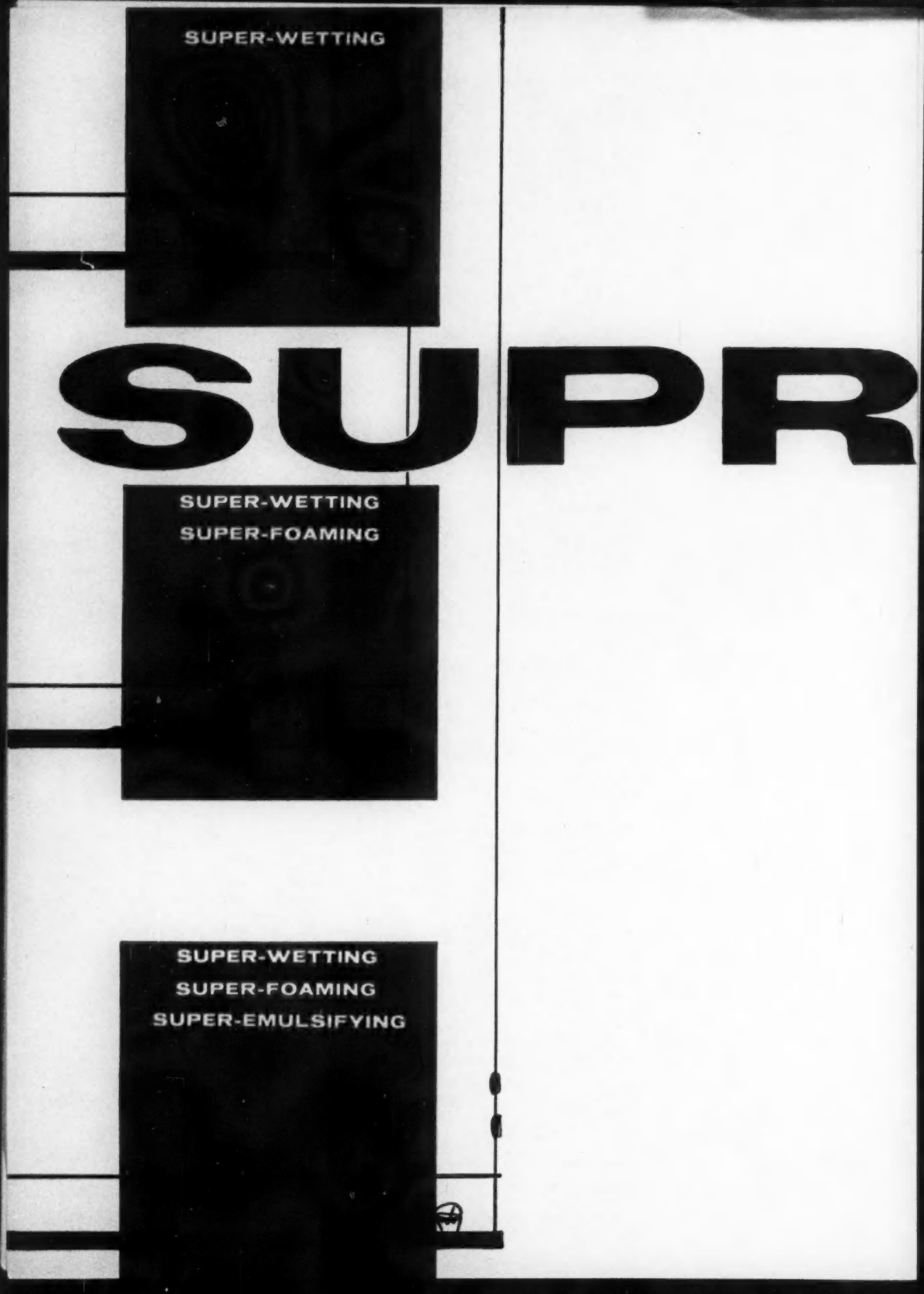
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LOW CHLORINE RETENTION. Produces crush resistant and stabilized effects on cottons and rayon. Emboset Loclor is one of the lowest chlorine retentive resins on the market today. Wherever fabrics are subjected to washing and bleaching . . . this is your resin! Low chlorine retention keeps yellowing and tensile strength losses at a minimum. The resulting finish is wash resistant, crease resistant and fully stabilized. A durable resin which produces highly efficient mechanical effects.

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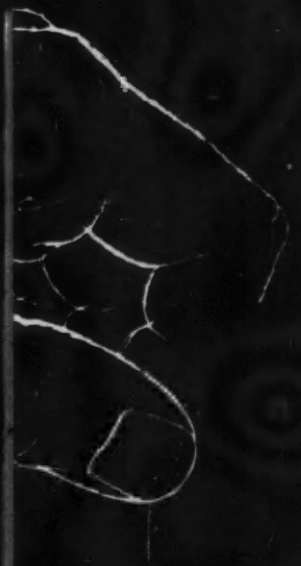

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The Norane line offers you a group of easily applied, single-bath durable water repellents. One of them is bound to provide exactly the combination of properties you need, no matter what fabrics you process. The Norane label assures customer approval and acceptance, while Warwick laboratory certification assures customer satisfaction. For complete information write Dept. WC8.

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375 Swift's distribution points located throughout the U.S. and Canada can give you immediate delivery on these Swift-quality soap products:

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for more than 25 years the textile industry's standard machines for testing

★ **color fastness** ★ **bleeding**
★ **shrinkage** ★ **resistance to mechanical action, etc.**
★ **detergency**

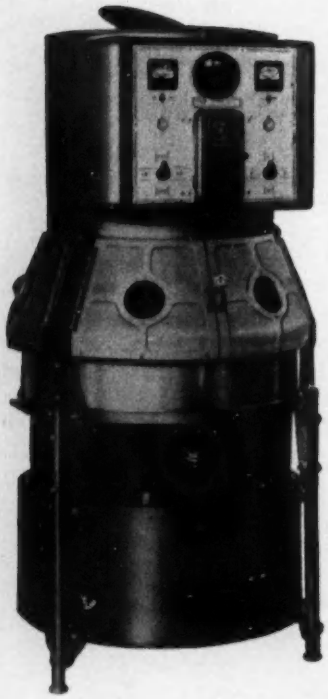
LAUNDER-OMETERS

As the standard washing machine of the A.A.T.C.C., the Launder-Ometer is used to reproduce quickly the destructive effects of commercial laundering practices of all types of fabrics. The New Metal Specimen Containers and Adaptor Plates are now available for use in the 2A, 3A, and 4A Washfastness Test which was designed to reproduce in one forty-five minute test the effects of five commercial launderings. Under these accelerated conditions, factual information is obtained that enables manufacturers to accurately predict color fastness to soaps and detergents, and resistance to bleeding, shrinking, washing and mechanical action. In addition, the Launder-Ometer is used for dyeing tests at boiling point.

Precision controls in the Launder-Ometer permit careful regulation of all factors, and identical reproduction of tests whenever desired. With its big capacity, the machine permits as many as 20 tests to be run simultaneously. The Atlas Pre-heating Loading Table—standard equipment on Launder-Ometers—makes it possible to start all tests at the same temperature, for greater accuracy. Mechanical action is provided by the introduction of stainless steel spheres or rubber balls into each container.

Located behind the Pre-heating Table, at the most convenient height, is the modern control cabinet housing all switches, pilot lights, indicating and control instruments, and direct-reading dial type thermometer. Launder-Ometers are available for use with electricity, steam, gas, or both electricity and steam for heating the water bath.

In the Launder-Ometer, all sheet metal parts coming into direct contact with water, including the test chamber and cover, and pre-heating loading table are constructed of stainless steel for permanent resistance to corrosion.



FADE-OMETERS

The Fade-Ometer brings under laboratory control the deteriorating action of sunlight on any material or type of finish. Used primarily to measure the light fastness of colors, the Fade-Ometer is also used to determine other photochemical changes caused by exposure to sunlight.

In making tests, samples in masked holders are rotated around an Atlas Carbon Arc — the closest approach to natural sunlight — at a fixed distance from the arc and at a constant speed in order to assure equal distribution of light to each sample. Upper and lower suspension rings keep samples in proper vertical alignment. Color fastness is measured in terms of Standard Fading Hours, using new calibration paper.

Operation of the Fade-Ometer is fully automatic. The simple, but complete control panel includes voltmeter, ammeter, running time meter, time switch, thermo-regulator, pilot lights and switches, which serve to keep all variable factors — time, temperature, humidity, and light — under accurate control.

The Fade-Ometer may safely be left in continuous operation overnight. It is furnished with water pan and specimen holders constructed of stainless steel and with a wide variety of sample holders and exposure masks.

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New AATCC developed instrument for rapid evaluation of wet and dry abrasion qualities of textiles.

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Standard machine for testing damage caused by retained chlorine. AATCC Tenative Test Method 69-52.

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QUADRAFOS® (Sodium Tetraphosphate)

METAFOS® (Sodium Metaphosphate) Excellent sequestering agents, dispersing agents, deflocculants and assistants for emulsifiers and detergents.

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QUADRENE — Liquid soap containing solvents. Jig, beck, kier caustic saturator.

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#65 PLISSE — fine particle — fast swelling.

#80 PLISSE — ready to use — gum and 50% caustic — convenience with controlled uniformity.

#200 VAT—15%—25% higher color yield.

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Ultrawet 60-L works with economical efficiency. A synthetic detergent, it leaves no soap curd to dull bright colors—heavy metal precipitates cannot be deposited, and even their formation is reduced. Crocking is ended because *Ultrawet 60-L* removes loose dyestuffs with ease.

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HERE is a new way to make cellulosic fibers more resistant to crease, yet avoid undesirable side effects. Standard treatment with urea-formaldehyde resins —while it does its primary job well—results in weakened fabrics.

Modifying the U-F resins with Hycar latex makes a big difference. Tests show that cottons and rayon-acetate fabrics treated with U-F/Hycar have markedly better tear, breaking, and bursting strengths, compared with fabrics treated with U-F resins alone.

There are other important benefits: Abrasion resistance is increased, colorfastness of many dyes is improved. Fabric life is increased and yellowing reduced compared to straight U-F, because a U-F/Hycar blend retains less chlorine, both in treatment and in subsequent laundering.

Hycar latices offer many other benefits to textile manufacturers and finishers. For information that may help you upgrade a product or sharpen its sales appeal, please write Dept. CQ-6, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

B. F. Goodrich Chemical Company

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American Latex

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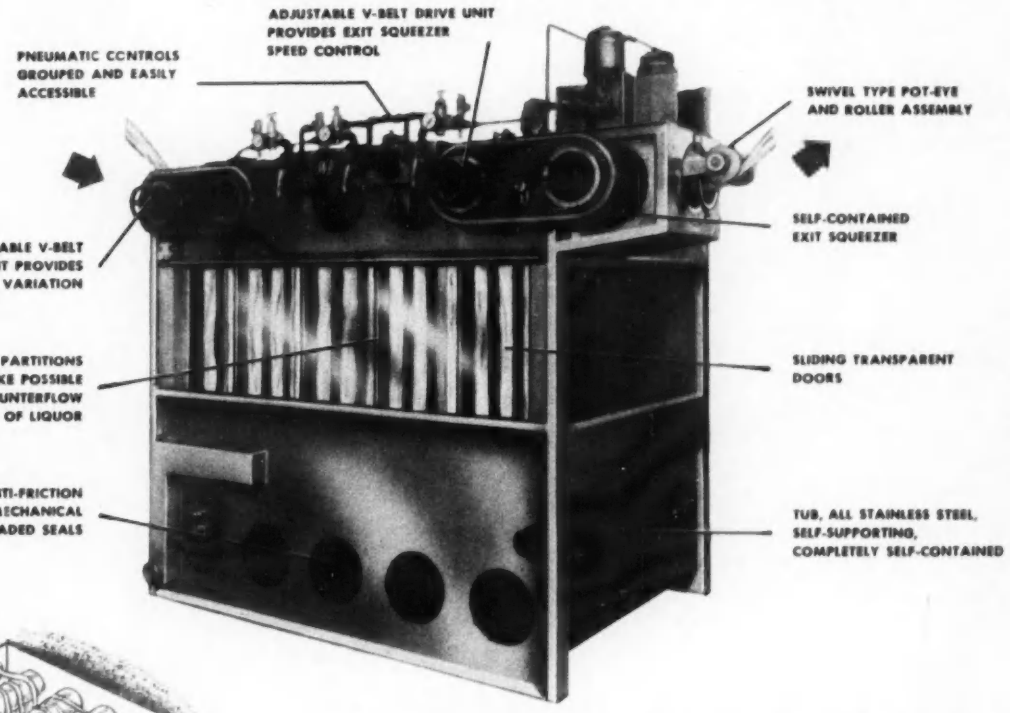
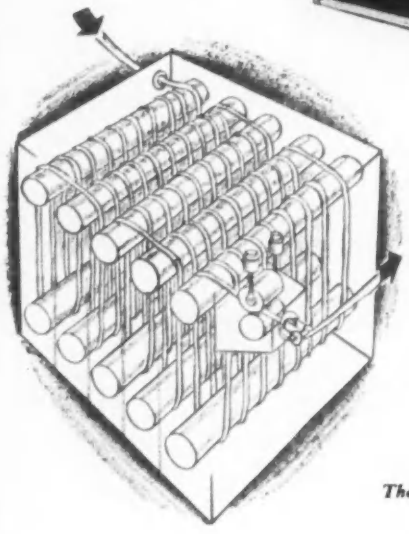
THE NEW WIESNER-RAPP
Multi-Stage Washer

(TRADE MARK) (PATENT PENDING)

VERSATILE... COMPACT... ECONOMICAL... ACCESSIBLE


ADJUSTABLE V-BELT DRIVE UNIT PROVIDES EXIT SQUEEZER SPEED CONTROL
PNEUMATIC CONTROLS GROUPED AND EASILY ACCESSIBLE
SWIVEL TYPE POT-EYE AND ROLLER ASSEMBLY
SELF-CONTAINED EXIT SQUEEZER
ADJUSTABLE V-BELT DRIVE UNIT PROVIDES ROLL SPEED VARIATION
SOLID PARTITIONS MAKE POSSIBLE COMPLETE COUNTERFLOW OF LIQUOR
SLIDING TRANSPARENT DOORS
EXTERNAL ANTI-FRICTION BEARINGS WITH MECHANICAL SPRING LOADED SEALS
TUB, ALL STAINLESS STEEL, SELF-SUPPORTING, COMPLETELY SELF-CONTAINED

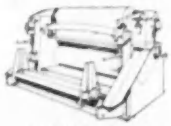


This totally-enclosed, high-speed multi-stage washer, of all stainless steel construction, will soap, wash, or treat a wide range of fabrics of various weights. It is compartmented to combine chemical or hot and cold processes. Auxiliary squeezers are designed to mount over any compartment. Great savings in water are possible because the washer is compartmented for positive counterflow. All compartments are free-draining and easily cleaned for quick changes from colored to white goods. The Wiesner-Rapp Multi-Stage Washer, which is shipped assembled, normally is mounted directly on the floor, with no pit required, and therefore little time is needed to put it in operation. It is easily threaded and can be used in harmony with other machines of a range or as an individual unit. Designed and built to Wiesner-Rapp high standards; requires minimum maintenance.

The Wiesner-Rapp technical staff will be glad to discuss Multi-Stage features with your personnel.

OTHER WIESNER-RAPP MACHINES

TIGHT-STRAND WASHER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Dear Jim:

Here is a snapshot of my boys. I know that you would like to see the men who solved your problems by producing that special polyvinyl acetate for your specific need. So many people have heard that we do attack each mill's problem individually and have made so many modifications in the emulsion polymers and copolymers for natural and synthetic yarns and fabrics, that we are building a new plant to accommodate the terrific demands.

I remember how skeptical some folks were when we began the individual approach. On the surface it did seem foolish. I heard so many complaints from plant supervisors and dye chemists who had tried one company after another and product after product without success, that I just had to tailor a specific product for the specific need. Now these users are certain that each product will have the same standards each time it is used. The peace of mind in this one fact means a lot, to say nothing of the actual savings.

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I'm looking forward to the opportunity of helping you with any other problems that you may have with your own new developments, whether in the fields of latices or resin emulsions.

Sincerely,

Bill

William Caldwell
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Ahcovat Soluble Green IB has excellent brightness and fine working and fastness properties.

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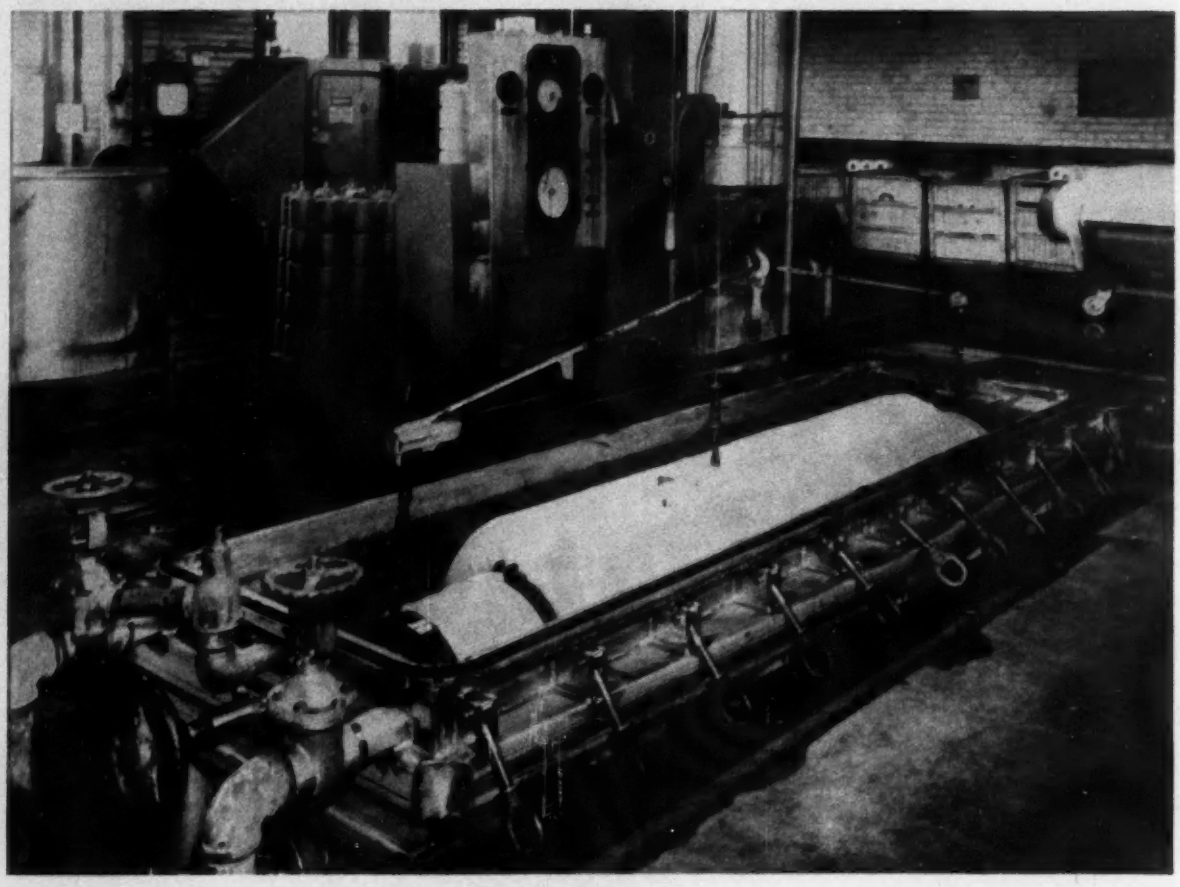

Taylor controlled Burlington Pressure Dye Machine installed at *Munsingwear, Inc.*

PICTURED ABOVE is a new Burlington Pressure Bleach, Boil-off and Dye machine recently purchased by Munsingwear, Inc. for use on tricot, and other knitted and open weave fabrics. With liquor being circulated through the machine at the rate of 1,500 gallons per minute the control of temperature and pressure is all important.

The Taylor Time-Schedule Temperature Controller automatically regulates rate of rise, hold time and temperature according to a predetermined ideal schedule. Pressure gages on either side of the controller indicate inside-out and outside-in pressures.

The Taylor control system saves money in at least four important ways:

1. It puts the whole process beyond the hazards of manual operation and human memory.

2. It assures a uniformly dyed product.

3. It makes possible a range of colors hitherto extremely difficult to obtain.

4. It saves labor through less material handling and shorter dyeing time.

When it comes to automatic control systems for dyeing, whether it's beam, piece, skein, package or top, Taylor engineers have the experience and the know-how based on many years of successful application in the Textile industry. Call your Taylor Field Engineer for practical advice and complete details. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

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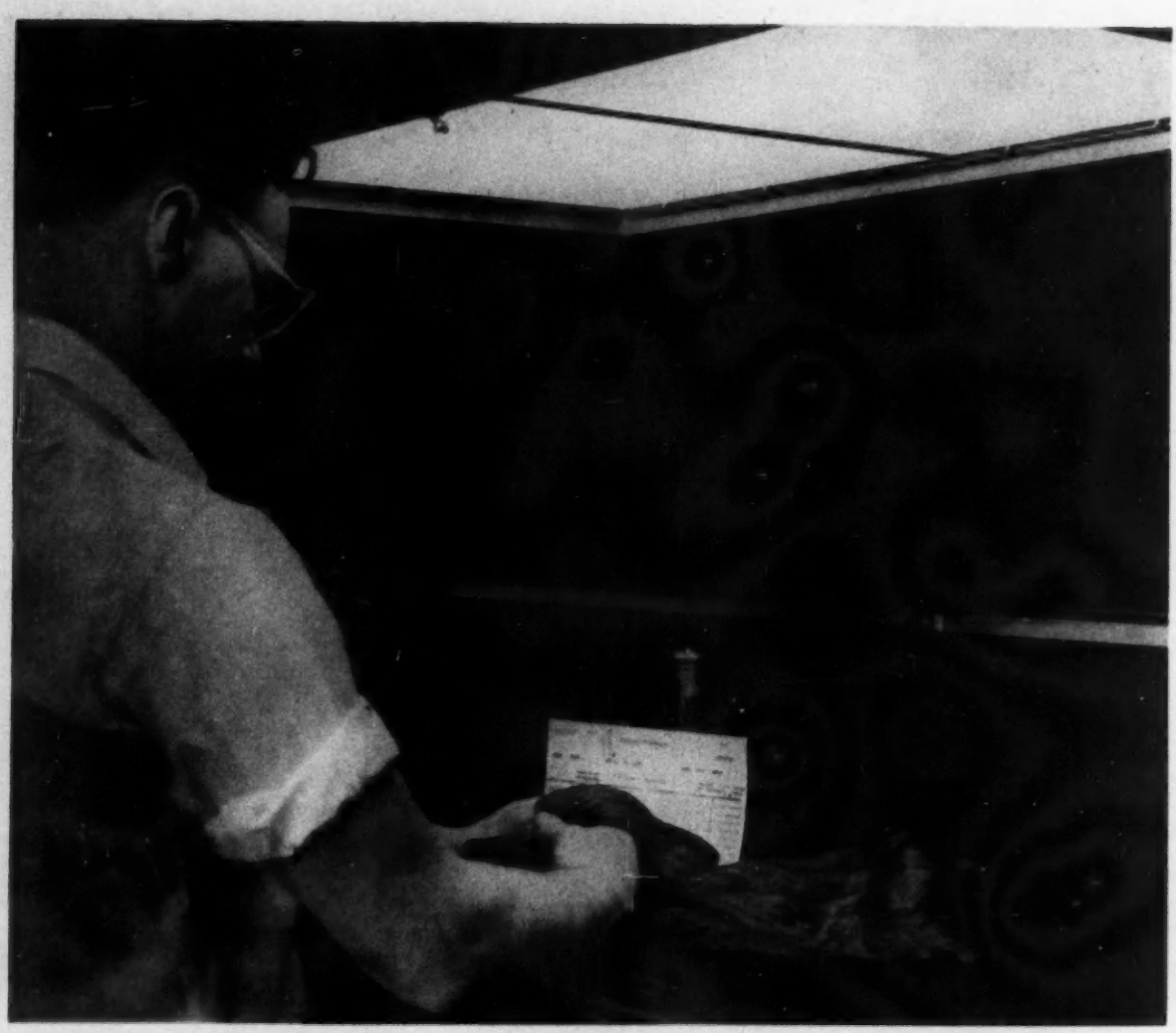

"VIRGINIA" SODIUM / HYDRO UNIFORMITY

assures perfectly matched shades in *your* dye house and cloth room

Accurate duplication of shades in dye house and cloth room is a "must" for smooth profitable operations. Many leading concerns the world over have made certain of perfectly matched shades for years by routine use of "Virginia" Sodium Hydro.

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Better still, ask for one of our technical service staff to call, survey your requirements, and develop an application of "Virginia" Sodium Hydro to your dyeing, reducing or stripping demands. Write or wire us today.

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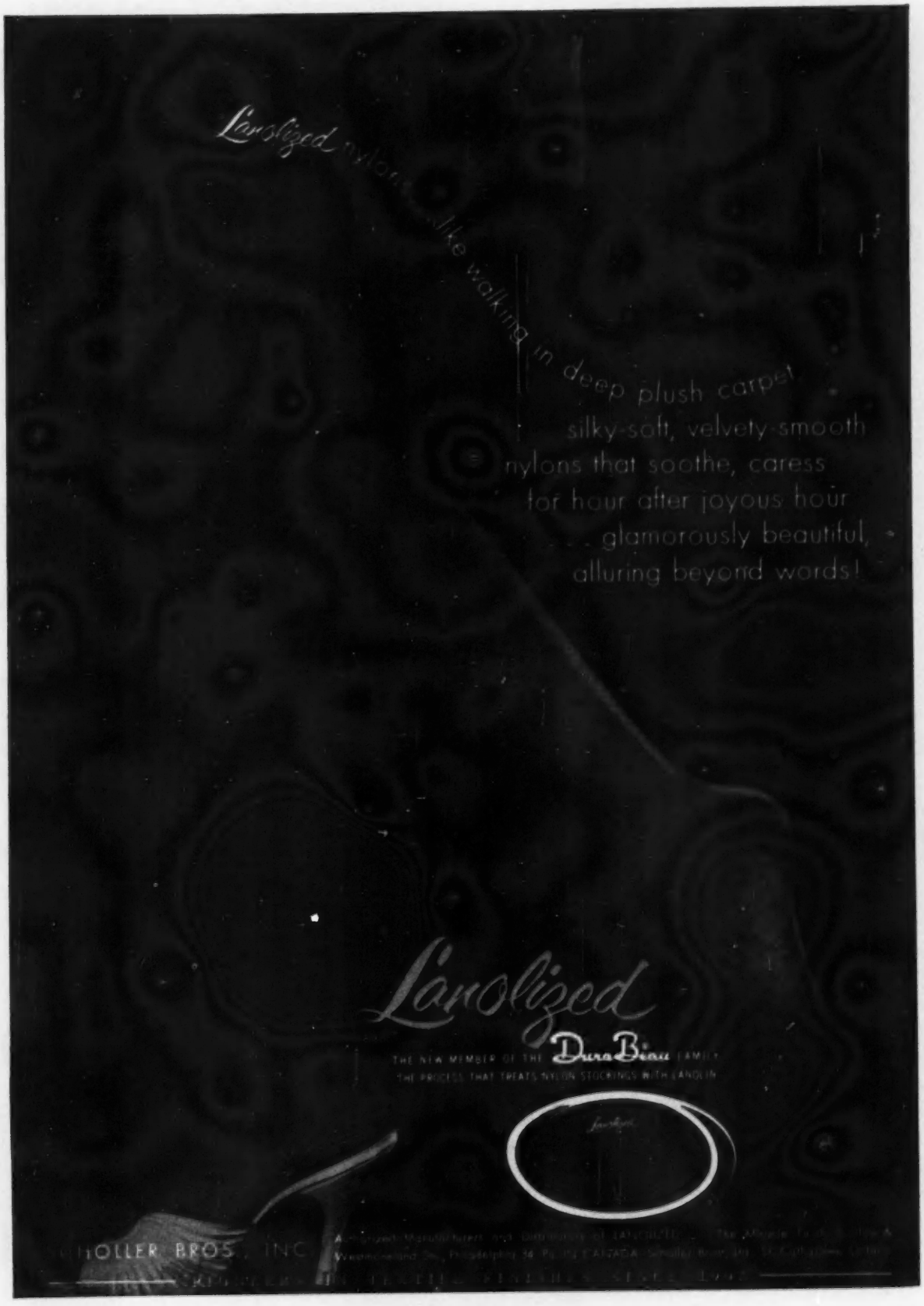
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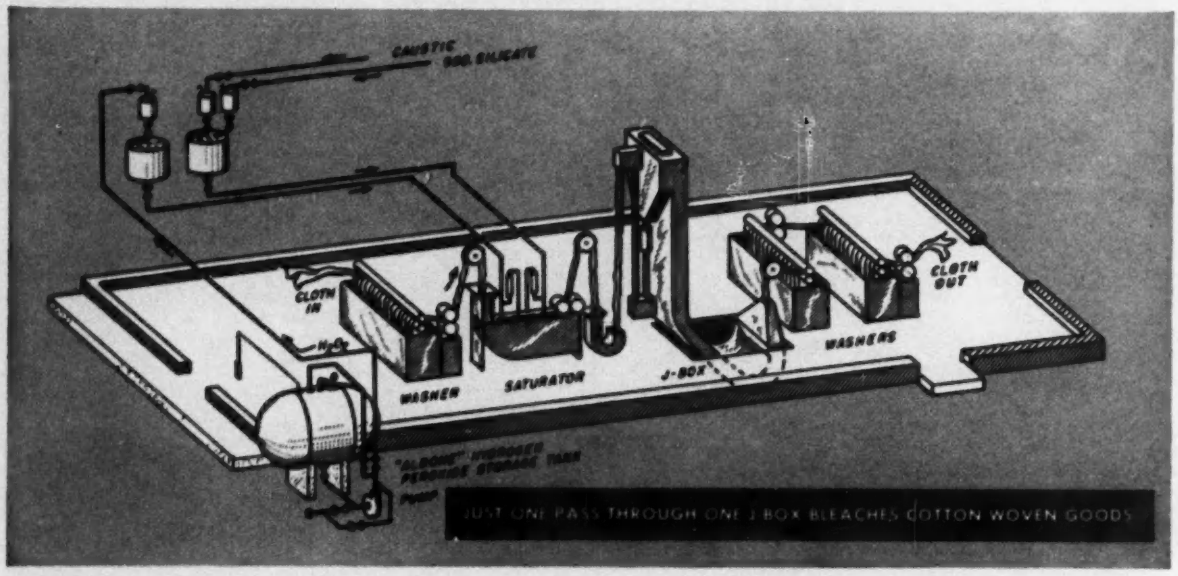

ONE-STEP single-stage continuous bleaching of cotton woven goods

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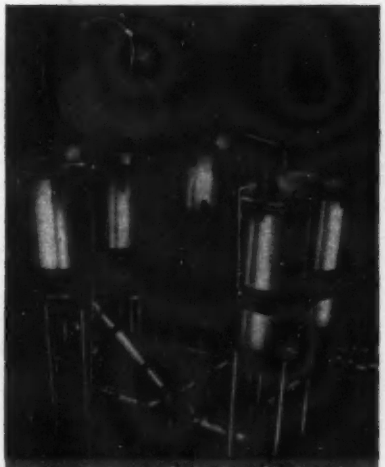

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Quality in denim, chambray, gingham and similar fabrics, depends greatly upon *uniform color*. This can be achieved only with *yarn* of uniform color . . . yarn without the slightest variation in shade. The Smith-Drum Beam and Package Dyeing Machine is designed to *insure absolutely level dyeing* of a complete set of beams or packages.

Level dyeing is possible *only* when all beams or packages in the same lot are dyed simultaneously in the *same bath!* This Smith-Drum Machine dyes from 2 to 6 beams or yarn carriers under identical conditions of liquor ratio, flow, pressure and temperature . . . with uniform distribution of additions to the dye bath.

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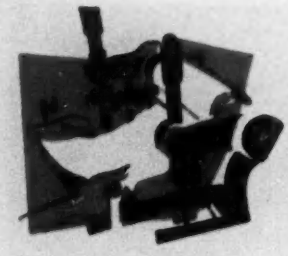
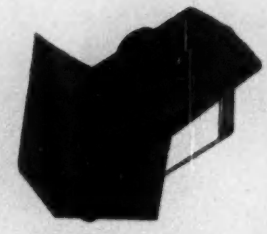
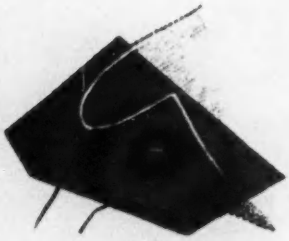


for paper treatment?

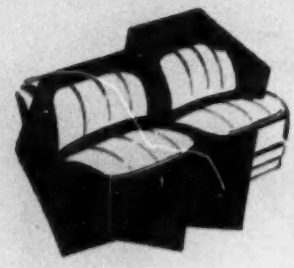


for leather finishing?

for water-based paints?

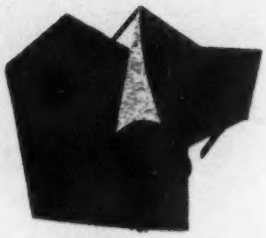


for rug backing?

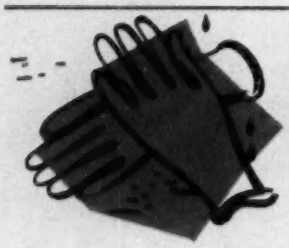


for textile sizing?

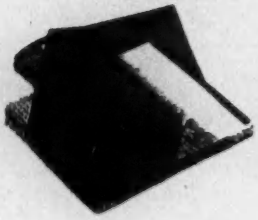
Have you tried a NAUGATUCK LATEX or LOTOL?



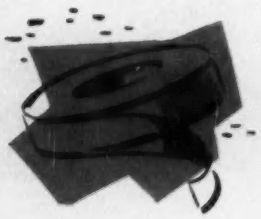
for bonding wood, leather, fiber?



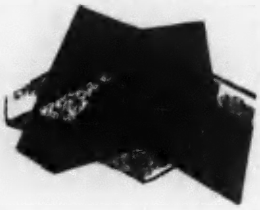
for dipped products?



for binding flooring, cushioning?



for pressure-sensitive tapes?



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Proceedings of the

American Association of Textile Chemists and Colorists

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Editor of Proceedings: Carl Z Draves

JUNE 6, 1955

AATCC CALENDAR

COUNCIL
June 17 (Hotel Statler, New York, N Y); Wednesday evening, Sept 21 (Chalfonte-Haddon Hall, Atlantic City, N J); Nov 18, Jan 20 (Hotel Statler, New York, N Y); Apr 20, 1956; June 15, 1956.

NATIONAL CONVENTIONS
Sept 22-24, 1955 (Chalfonte-Haddon Hall, Atlantic City, N J); 1956 (Waldorf-Astoria, New York); 1957 (Boston); 1958 (Chicago); 1959 (Washington, DC—tentative).

HUDSON-MOHAWK SECTION
June 17 (Annual Outing—Normanside Country Club).

MID-WEST SECTION
June 10-11 (Annual Outing—Lake Lawn Lodge, Delavan, Wis); Oct 29 (Bismarck Hotel, Chicago, Ill).

NIAGARA FRONTIER SECTION
June 17 (Annual Outing—St Catherines Country Club, St Catherines, Ont)

NEW YORK SECTION
June 17 (Outing—North Jersey Country Club, Wayne, N J).

NORTHERN NEW ENGLAND SECTION
June 10 (Annual Outing, Wachusett Country Club); Oct 14; Dec 9.

PACIFIC SOUTHWEST SECTION
June 3, Oct 7, Feb 6 (Gourmet Restaurant, Beverly Hills, Calif); Dec 2.

PHILADELPHIA SECTION
Oct 21 (Penn-Sherwood Hotel); Dec 2, Jan 13 (Kugler's Restaurant).

PIEDMONT SECTION
June 10-11 (Mayview Manor, Blowing Rock, N C); Oct 29 (Hotel Wm R Barringer, Charlotte, N C).

RHODE ISLAND SECTION
June 10 (Annual Outing, Pawtucket Country Club, Pawtucket, R I); Oct 13, Dec 1 (Johnson's Hummocks, Providence).

SOUTH CENTRAL SECTION
July 29-30 (Lookout Mtn Hotel, Chattanooga, Tenn); Dec 10 (Hotel Patten, Chattanooga, Tenn).

SOUTHEASTERN SECTION
Sept 10 (Ralston Hotel, Columbus, Ga); Dec 3 (Atlanta Biltmore, Atlanta, Ga).

WESTERN NEW ENGLAND SECTION
June 17 (Annual Outing, Wallingford Country Club, Wallingford, Conn); Sept 16 (Rapp's Restaurant, Shelton, Conn); Nov 4 (Hartford, Conn); Dec 16 (Rapp's).

ACTIVITIES OF THE LOCAL SECTIONS

HUDSON-MOHAWK———Forty-six members and their wives were present for the annual Ladies Night program of the Hudson-Mohawk Section on May 20th at the Schuler Meadows Country Club, at which Lucille Harlow of the Mohawk Carpet Co discussed interior decorating with suggestions for color scheming. Miss Harlow supplemented her talk with many fabric displays illustrating her ideas.

Another feature of the meeting was the presentation of the Dr Jack Epelberg Memorial Award to John W Merrill, superintendent of the Standards Testing Laboratory, Cluett, Peabody & Co. The Award, presented to the Section by Mrs Jack Epelberg, is given annually to that member who has done most for the Hudson-Mohawk Section. Mr Merrill for several years served as chairman of the Dining Committee and is now treasurer of the Section.

A dance concluded the evening's events.

* * * *

NIAGARA FRONTIER———AATCC's newest Section, the Niagara Frontier, will hold its first annual outing on June 17th at the St Catherines Country Club, St Catherines, Ontario, Canada. Salvatore J Puliafico, National Aniline Div, Allied Chemical & Dye Corp, heads an Outing Committee which has arranged for a golf tournament and other activities. Activities other than golf will be handled by Anton Viditz-Ward, Van Raalte Co, Inc.

* * * *

SOUTH CENTRAL———John J Singer, director of technical sales for Versenes, Inc, discussed "Chelating of Metals in Dyeing, Bleaching and Finishing Baths" at a quarterly meeting of the South Central Section held at the Hotel Patten, Chattanooga, Tenn, on May 14th. Approximately 75 were in attendance. The group was entertained by a professional magician at the Banquet.

Plans have been completed for the Section's annual outing, which will be held July 29-30 at the Lookout Mountain Hotel atop historic Lookout Mountain in Chattanooga. Sectional chairman Joe T Bohannon, American Aniline Products, Inc, has announced that Lowell Shive, Arnold, Hoffman & Co, Inc, will serve as outing chairman, and W G Agnew, Dixie Mercerizing Co, as cochairman. Other Committeemen are: C E Rollins, Dixie Mercerizing Co, *finance;* J Henry Henderson, Jr, United Hosiery Mills, *publicity;* Mrs Glenn Bellamy, *ladies;* Charles Starnes, American Aniline Products, Inc, *golf;* Everett Burgner, Davenport Hosiery Mills, *entertainment;* LeBron Madaris, Crystal Springs Bleachery, *men's sports;* Jack McNab, Mac Chemical Co, *prizes;* William Dooley, Dooley Chemical Co, *registration.*

* * * *

WASHINGTON———The Washington Section, for its last meeting of the '54-'55 season, last month sponsored a symposium on "The Role of Government in the Textile Industry". Panelists included Harvey H Hannah, chief of the Federal Trade Commission's Division of Wool, Fur and Flammable Fabrics; William D Appel, chief of the Textile Section, National Bureau of Standards; G E Hilbert, director of the Utilization Research Service, U S Dept of Agriculture; and A Henry Thurston, chief of the Textiles and Clothing Division, Office of Defense and Business Services Administration of the U S Dept of Commerce.

* * * *

AATCC Newsgram

June 6, 1955

NEWS IN GENERAL

Some initial evaluation of last month's atomic explosion on the mannikins exposed was made on the spot at Nevada, but the main evaluation on fabric samples exposed will be made at AATCC Research Laboratories, upon arrival of the frames at Lowell, Mass. These frames are presently in transit. . . . Members of the AATCC team at the shot site will make a detailed report to the AATCC Convention in September.

Plans are progressing rapidly for one of AATCC's biggest and best conventions and exhibits in September at Atlantic City. Data already supplied by exhibitors forecasts one of the Association's most interesting trade shows. Examples of what will be on display (picked at random from the latest exhibitors' list): Alco Oil & Chemical Corp will show treated carpets and upholstery material; Custom Scientific Instruments, high-speed recording tensiometer and testers for pilling, electric resistance, etc; Goodyear Tire & Rubber Co, various types of Latex products; Kennett Equipment & Machinery Co, tanks and materials handling equipment. . . . These are only a few of the many firms already signed up. We'll try to squeeze in exhibit data on some of the others next issue.

AT RESEARCH HEADQUARTERS

Recent visitors to AATCC Research Labs at Lowell included W C Duckworth, of the Tennessee Corp Research Labs at College Point, Ga, and Alton A Cook, technical director of the Arkansas Co.

Specimens are being prepared at Lowell headquarters for a second preliminary trial run on shrinkage determination, tumble drying, for John Warner's Committee on Tumble Drying – a subcommittee of the Committee on Dimensional Changes in Textile Fabrics. . . . Research staff at Lowell has just completed two of three projects requested by Committee on Fastness to Washing. . . . The two projects involved 1) comparison of staining of multifiber test fabric in the No. 3 test, versus the 3A wash test, and 2) the determination of the effect of detergents with and without optical bleach in the 2A, 3A and 4A wash tests. . . . A total of 270 specimens have been sent to P J Fynn for evaluation by that Committee.

COMMITTEE NEWS

Joseph Norton has been appointed to the Technical Committee on Research, chairman Charles Dorn reports. . . . TCR's next meeting will be June 17 at the Hotel Statler, New York, and at this meeting, Frank Rizzo, of QM, will speak on the QD No. 7 problems, discussing the effect of fabric preparation on ultimate fastness. . . . Theodore Cooke has been named to the Committee on Damage Caused by Retained Chlorine. . . . Charles Sylvester, chairman of the new special ECR Committee on End-Use Performance Tests, reports the following are members of his Committee: H C Donaldson, Jr; E Freedman; P J Fynn; secretary; S J Kennedy; Jules Labarthe, Jr; Philip B Roth; R H Souther; H L Stutz and G S Wham. . . . Objectives of this committee are 1) to effect better correlation between AATCC tests and end-use performance, and 2) to promote new tests or combinations of tests to predict end-use performance. . . . The committee will investigate wear tests made available by industry and when applicable, channel these to the proper subcommittees for correlation with existing tests, or for use in developing new ones.

TCR's Committee on Bleaching reported it will try to obtain more mill personnel who are or should be vitally interested in the Committee's work, which includes study of tests for determining the fastness of colors to peroxide bleaching, and development of a set of standard concentrations for potassium permanganate, sulfuric acid and other solutions used in analyzing bleaching baths. . . . Light Fastness Committee reports it will concentrate on investigation of the proper method of testing for sunlight fading. . . . The project will be started in June and carried on for one year.

Atlanta Convention——

Symposium on Waste-disposal Problems of Southern Mills

The following opening address, papers, and panel statements constituting the Symposium were presented on Friday morning, Sept 17, 1954, in the Empire Room of the Atlanta Biltmore Hotel in Atlanta, Ga.

PANEL—(L to r): Edmund A Leonard, Alexander Smith, Inc; W R Steele, Semet-Solvay Div, Allied Chemical & Dye Corp; George A Rhame, Water-Pollution Control Authority, South Carolina State Board of Health; E C Hubbard, Stream-Sanitation Committee, North Carolina State Board of Health; William H Weir, State of Georgia Dept of Public Health; R Hobart Souther, symposium chairman, Cone Mills Corp; T A Alspaugh, Cone Mills Corp; D F Smallhorst, Bureau of Sanitary Engineering, Texas State Dept of Health; John L Brown, Cannon Mills Co; Duane W Snyder, Crompton-Shenandoah Co, Inc; Lewis A Young, U S Public Health Service. Percival Theel, Philadelphia Textile Institute, was not present when photo was taken.

OPENING ADDRESS BY THE CHAIRMAN

R HOBART SOUTHER[1]
Cone Mills Corp
Greensboro, N C

THE purpose of this symposium is better to acquaint the members of our Association with the problems of stream pollution. The shift of textile processing from the North to the South has created many new problems as well as new opportunities. Especially the need for clean water for the South has increased because of the rising industrialization and accompanying population shift.

The treatment of textile waste is a field in which the textile chemist should be more concerned than ever as a result of increasing demands from state and national levels for better pollution control of streams. It is a field in which he is most eminently qualified by his greater knowledge of the properties of dyes and other auxiliary chemicals requiring treatment and removal from waste waters. To this end a committee of the AATCC has been formed to promote, encourage, and inspire further research and exchange of information among members of our Association. This work will be discussed later by some of our panelists.

The research required for the solution of textile-waste-disposal problems may be divided into two broad classifications: first, that type of research which is needed for the solution of each local problem: and, second, that type of research which will be generally applicable and which will be useful in solving various types of individual problems.

Conditions vary so much from one textile plant to another that each individual plant requires considerable study to determine the most economical and efficient method of treating its waste. Here, plant chemists can best solve the problems, because of their better knowledge and experience with the plant processes producing the waste. There are still vast unexplored regions for research open to the textile technical personnel in reducing waste in the plant, and finding substitutes with low pollutional potential for the present chemicals with high pollution qualities. One of the speakers will present a paper on experiences in this field.

That research which will be generally applicable is open to anyone interested in studying stream-pollution problems. Here the universities, state agencies, and associations can be most helpful to the textile industry if wise use is made of their facilities and staff available for investigating all phases of a general problem.

One of the speakers will explain the cooperative program that is being carried on with the state, interstate agencies, industries, and others who are concerned with conserving the quality of water resources. There are representatives here of most of the southern states' health departments, who will explain how their state laws affect textile waste disposal. Some of the objectives and accomplishments of the National Technical Task Committee on Industrial Wastes will be discussed. In this symposium we will also hear some actual case histories of problems that have been investigated and solved by the textile plant personnel.

Co-operation between the city, state, and plant personnel will be needed for final disposal of the textile plant waste to the streams. Your National Committee on Stream Pollution seeks the help of every interested member in striving for this goal. It would be difficult to find a better way to serve the best interests of our Corporate Membership.

[1] Present chairman of the National Stream-Sanitation Committee of AATCC.

RELATION OF FEDERAL STEAM-POLLUTION LAWS TO INDUSTRY

LEWIS A YOUNG[1]
U S Public Health Service
Atlanta, Ga

Practical evidence of the effectiveness of team work in solution of waste disposal problems has been shown. The cooperative program that is being carried on with the states, interstate agencies, industries, and others who are concerned with conserving the quality of water resources is discussed.

Many of the states have different laws and different requirements for meeting specific standards. The interpretation of these laws in relation to the work of the Public Health Service is discussed.

THE abatement of pollution is everybody's responsibility, but too often a task that is everybody's responsibility is left for someone else to do. There is nevertheless a growing public awareness of the need for water conservation and water-resources development. The droughts which curtail normal uses of the water make us realize our dependence upon an adequate water supply. Our modern way of life and expanding industrial development require ever-increasing quantities of good clean water.

The water of the earth is in a continuous cycle. It is transpired and evaporated from the land and the water surfaces into the atmosphere. It returns to the land as rain. The rainwater that runs off or seeps into the ground becomes our water supply.

The variations of rainfall in any one area may cause floods or extended droughts, but the average annual rainfall for the entire United States remains nearly constant. Water must be conserved and reused to meet our growing demands.

The Southeast is blessed with a wealth of water, the most essential of all natural resources. The water normally abundant in all parts of the area is of good chemical quality, well suited for industrial and domestic use. Supplies may be obtained from hundreds of smaller streams and from the dozens of rivers that are formed as the waters flow down from the mountains to cross the Piedmont to the Coastal Plains into the Atlantic Ocean and the Gulf of Mexico. In addition to providing water for man's many uses, these same streams must also carry away his waste.

Each river system has its own peculiar set of conditions, which affects the ability of the stream to assimiliate the wastes it receives. Organic, inorganic and toxic waste adversely affect the water quality, and, when the limited ability of the stream to assimilate the waste it receives is exceeded, the stream becomes polluted. The water is then of unsatisfactory quality for many uses and the pollution should be abated.

An important objective of water-pollution control programs is to establish and maintain economic balance among all the reasonable water uses, including the use of the stream for waste disposal. It can be accomplished best by the development of a comprehensive plan for the entire drainage basin, since conditions in one reach of the stream have their effect on downstream water quality and use. The abatement of pollution should be by co-operative effort. The individual citizen, industry, and the city must assume their responsibility and cooperate with the State Agency.

Water-pollution control programs need to be geared to the development of the area. Intelligent planning will assure the maximum judicious use of the water resources for the greatest public benefit. The control of water quality in the streams will permit the greatest development of the area.

All the forty-eight states have water-pollution control programs, and their objectives are essentially the same. Most of the states have definite water-pollution control legislation. Twenty-one have developed water-quality requirements or objectives for each of the water uses. Sixteen additional states are developing, considering, or have legislative authority to develop and adopt such criteria. While specific legislation is important for the development of uniform programs for water-resources protection, you cannot legislate water-pollution control.

The state programs differ in their approach since they have been developed under a variety of state laws. The primary objective of the state water-pollution control program is the protection of public health and welfare; of equal importance is the development of the state's water resources. State agencies should work with cities and industries in aiding them to solve difficult pollutional problems, giving advice and counsel on the type of treatment needed. They should co-ordinate all program operations involving interstate, state and local governments and industrial water-pollution control activities within the state.

It is not possible in the time allotted to describe or discuss all the various types of state water-pollution control programs or the variations in state laws under which state agencies must operate. I will, however, briefly describe the program in North Carolina. This State has had a 14 percent increase in population in ten years and more than a 50 percent gain in the number of manufacturing establishments in a two-year period.

This growth indicates real progress. Accompanying it is also the serious problem of handling the increased sewage and industrial wastes which are discharged into North Carolina rivers and streams. Increased water pollution is an indication of growth; unabated, it also limits the development of the area. Polluted water is useless water and of little more value than no water at all.

In 1951 the North Carolina legislature established the policy that the water resources of North Carolina should be utilized to the best interest of the people. The State Stream Sanitation Committee was created and charged with the responsibility of maintaining the quality of the State's waters.

The State program will assure:

1) Adequate resources of public and industrial water supplies, which will be safe and satisfactory after reasonable treatment.

2) Water suitable and safe for recreational purposes.

3) Waters capable of maintaining fish and wildlife.

4) Waters usable for agricultural purposes.

5) Waters adaptable for other legitimate purposes.

6) Waters free from unsightly, evil-smelling nuisances.

First, the Committee will decide how each stream can best be used for the good of all and determine what water quality each use will require. Second, they will classify each stream according to its present and future uses. Results of detailed studies of the water characteristics will then be presented at public hearings. All the streams will be classified on the basis

[1] Officer in charge, Southeast Drainage Basins Office, DHEW, PHS, Division of Water Pollution Control.

of available facts including the evidence given at the hearings.

The data on the first stream studied have been presented at public hearings. The obtaining of necessary data for each stream, the development of reports and the holding of public hearings will take time, but in the meantime pollution abatement can continue on a voluntary basis and need not be postponed until comprehensive plans for the basins have been developed.

Research on methods of treatment for the wastes, and voluntary abatement will be encouraged. The municipalities and industries will be aided and encouraged in more effective operation of existing facilities.

The final phase of the program is the actual control and abatement of pollution after facts on stream conditions are brought to the attention of the people of the State. Finally, and only if the cities and industries do not do their part voluntarily, will they be required to comply with abatement orders and compelled to construct remedial works.

Other states in the Southeast are developing similar programs, although some vary considerably from that of North Carolina.

Where a state water-pollution control program is adequately staffed, the state agencies will welcome an opportunity to work with industry in the solution of its waste problems. Improvements in processes and better housekeeping methods may reduce both the strength and volume of industrial waste.

Many of the industrial wastes do not respond to the present known types of treatment, or the treatment is far too expensive to be economically feasible. Therefore, in the location of new industry the aid of the state agency should be solicited, since it will be able to help select the site where a minimum amount of treatment will be adequate to prevent pollution of the receiving waters. Existing industry may be able to reduce greatly the pollutional effect of their waste by better housekeeping or improved methods in their plants. In some instances such improvements in operation may afford considerable saving as well as elimination of objectionable pollution in the receiving stream.

After the passage of the Federal Water-Pollution Control Act in 1948, conferences were held with the states regarding the establishment of Federal policy for the prevention and control of water pollution. The Federal Program does not duplicate a state's efforts but supplements its programs. The states on request can obtain consultative and technical services which they cannot afford to maintain on a permanent basis.

The Federal interest in water-pollution control is parallel to that of the states. The primary objective is the protection of the health and welfare of the people. Of equal importance is the conservation of the national resources, since this is the key to industrial expansion and is of extreme importance to our standards of living, national economy and national defense.

The widespread nature of pollution and the fact that the problem is increasing in spite of the very earnest efforts of the state water-pollution control agencies are of particular concern to the Federal Government. Pollution is no respector of state boundaries, and the benefits which would accrue from its abatement would not be limited to one state.

The Federal program serves as a catalyst to speed up the state water-pollution control programs, through public information and research programs, the coordination of state activities, and the promotion of uniform policies. It is not the Federal policy to work directly with individual industrial plants for the solution of their industrial-waste problems. However, field studies of industrial-waste plants to determine the type and quantities of waste produced have been made for the purpose of preparing guides which will assist the states in the study of industrial-waste problems.

Through the National Technical Task Committee on Industrial Waste the Public Health Service has worked very closely with industry in research studies of industrial-waste treatment. Industry has shown its willingness to co-operate in the program by demonstrating that it recognizes its responsibility in the development of treatment methods to meet its own waste problems.

A subcommittee on dairy-waste disposal in co-operation with the National Technical Task Committee on Industrial Wastes recently released an industrial-waste guide for the milk-processing industry.

A committee on meat-packing-plant-waste disposal of the American Meat Institute has completed an "Industrial Waste Guide for the Meat Industry," which will be distributed soon.

The National Committee on Stream Pollution of your organization, the American Association of Textile Chemists and Colorists, was formed through the efforts of the textile-industry representatives on the National Technical Task Committee on Industrial Waste. Your Committee has established Regional Stream-Pollution Committees, each with a particular assignment on some phase of the waste-control problem. The Sectional Committees permit the members to work closely together on a particular phase of the industrial problems peculiar to an area. The industrial-waste problems of the textile industry vary considerably in the various sections of the country.

The Rhode Island Sectional Stream-Pollution Committee has prepared a glossary on waste treatment and stream pollution, which was published in the October 12, 1953 issue of *Am Dyestuff Reptr.* This same group also studied the application of oxygen-demand tests to a large group of textile-processing liquid wastes.

The Piedmont Section in co-operation with some other local sections has prepared a complete bibliography of the literature on textile wastes.[1]

The textile industry has wisely taken the position that it is necessary to proceed first with studies of some of their more basic waste-control problems. They are planning to develop an industrial-waste guide for the industry after they have accumulated the necessary basic information.

Other industrial groups have similar committees, which are working toward the development of industrial-waste guides. One of the primary functions of these groups has been to serve as a medium for obtaining, developing and exchanging information and materials among their industry in regard to the handling of their particular types of industrial wastes. The Committee members have commented that this interchange of information has proven very beneficial to them, and they have expressed the belief that it is also of great benefit to industry in the development of methods for the satisfactory handling of their industrial wastes.

The enforcement provisions of the Federal Water-Pollution-Control Act are applicable only regarding interstate pollution. It is not the intent of the Federal Water-Pollution-Control Act to legislate for the individual states but to encourage them in the development of adequate, efficient, water-pollution-control programs. The states may, however, invite the Federal Government to assist them in bringing about the necessary remedial measures.

The effect of the Federal Water-Pollution-Control Act in the Southeast is apparent in the increased appropriations that most States are now making available for their water-pollution-control programs. Five states in this area have specific water-pollution-control legislation and are developing comprehensive basin-wide water-resources conservation programs.

Clean streams mean new life for industry. We have a moral obligation to abate pollution, to keep our streams clean, and to preserve our natural resource. Benefits which will be derived from pollution abatement will justify whatever costs are necessary.

[1] Editor's Note: This appeared in the March 14, 1955 issue of *Am Dyestuff Reptr.*

COTTON SLASHING WITH SYNTHETIC COMPOUNDS AS A MEANS TOWARD POLLUTION ABATEMENT

DUANE W SNYDER

Crompton-Shenandoah Co, Inc
Waynesboro, Va

A discussion of the problem of stream pollution resulting from the discharge of process wastes from Crompton-Shenandoah's dyeing and finishing plants and the steps taken toward solving the problem by substituting synthetic film-forming compounds for natural sizing materials are presented in this paper. The possibility of reducing over-all pollution coming from cotton dyeing and finishing plants by as much as seventy percent is in evidence as indicated in the context through auxiliary chemical substitution.

INTRODUCTION

THE pollution-abatement problem confronting the Crompton - Shenandoah Company is similar to that of many cotton-dyeing and finishing plants which discharge their wastes from wet processes directly into relatively small streams. This pollution must be reduced to acceptable levels in order that our natural water resources can be conserved. The question as to what constitutes the most practical approach to the problem must be answered before any constructive results can be expected.

Treatment of textile wastes by any of the known methods will require large outlays of capital expenditure and high operating costs. The method of "in-plant" process changes, on the other hand, as a means toward pollution abatement shows great promise, in that net operating costs are changed very little. In many instances "in-plant" process changes resulting in reduced pollution loadings will show savings in production costs. The question can be answered only after long-term studies of the various processes have been made. The Crompton-Shenandoah Company has embarked on an abatement program, based upon long-term studies of the problem, which seeks satisfactory pollution abatement through "in-plant" process changes.

The object of this paper is to present the factors leading up to the studies of the major sources of pollution, and the methods being investigated toward its elimination. The discussion is concerned primarily with desizing wastes; the dye waste is discussed briefly because of its importance in the over-all pollution picture.

Inasmuch as desizing wastes are directly related to the compounds used in warp slashing, the title of this paper is obvious.

HISTORICAL DISCUSSION

Initial studies of the effluents from the various wet processes showed that a total biochemical-oxygen-demand (BOD) loading from the finishing plant averages 3,000 pounds per day. Many treatment methods were investigated in pilot plants, and the results of these studies indicated that the most economical treatment method is that of high-rate biological filtration without prior chemical modification. The pilot-plant data showed that this system of treatment could be expected to have an efficiency of 75-80%. A full-scale treatment plant, designed from the pilot-plant data to handle 1.75 mgd (millions of gallons per day) of waste, was estimated to require capital investment in the amount of $250,000, with an estimated operating cost of $10,000 per annum.

Analysis of the individual process wastes, as given in Table I, shows the percentage of BOD load produced by each process. It can be seen that, if a reduction of at least 70% of the total pollution load can be made at the source, the need for a treatment plant would be highly unlikely.

Consider first the major source of pollution, ie, the desizing process. Since this waste is due to the digested starch residues, this problem must be attacked from the standpoint of the slashing operation.

It has been known for some time that certain film-forming materials of a synthetic nature exhibit relatively low BOD values in comparison with natural sizing materials *(1,2)*. Some of these differences in BOD are shown in Table II. It can be seen from these data that it is possible to reduce the pollution stemming from the desizing process tremendously if the starch or starch derivatives could be replaced with one or more of the synthetics having low BOD values. The synthetic must, of course, have physical properties similar to the natural materials used in slashing.

The major drawback to the use of synthetic compounds in cotton slashing has heretofore been the cost differential between these and natural products. However, by taking into consideration the high cost of treatment facilities, it would seem logical that some material exerting low BOD could be found to replace starches or portions thereof and still maintain an economical balance in producing textiles.

Dan River Mills, Inc, had done considerable research work utilizing synthetic sizing compounds in 1944 and 1945 on cotton warps in order to improve weaving efficiency. They had used polyvinyl

TABLE I

PERCENT OF BOD LOAD CONTRIBUTED BY FINISHING PLANT PROCESSES

Origin	*Description*	*% BOD Load**
Desizing	Soluble-starch residues and enzymes	52.5
Dyeing	All classes of dyestuffs and auxiliary chemicals	37.2
Bleaching	Highly alkaline detergent wastes	10.3

* Total BOD load, approximately 3,000 lb/day.

TABLE II

COMPARISONS OF BOD VALUES EXERTED BY SYNTHETIC AND NATURAL PRODUCTS

Product	*BOD * ppm*	*lb BOD per lb of Material*
Methylcellulose	1.6	0.0016
Carboxymethylcellulose	9.0	0.009
Polystyrene derivative (Stymer)	12.0	0.012
Polyvinyl alcohol (89½ hydrolysis)	16.0	0.016
Corn starch, acid-modified	477.0	0.477
British gum	690.0	0.690

* BOD on 1,000 ppm solution.

alcohol and carboxymethylcellulose (CMC) in these studies and found that weaving properties were equivalent to that of starch-slashed warps. Since Dan River Mills and Crompton-Shenandoah Company have similar pollution problems, an agreement between the two organizations was reached whereby information pertaining to this problem would be exchanged.

When the weaving data were made available to the Crompton Company, it was easily converted to our application so that cost calculations could be made to determine the feasibility of further pursuit into the study of synthetic substitution in warp slashing. The cost calculations considered the amortization rate of the proposed treatment plant and the desizing chemicals as savings on and above the normal cost of starch. It was determined from these calculations that it would be practical to use product "x" as a size if it cost no more than 40 cents per pound and could be used from a solution of not more than 6 percent solids and a yarn solids add-on not to exceed 15%. The search then began for a suitable material to meet these requirements. Carboxymethylcellulose seemed to be the first most likely product for experimental work since the CMC-CT low-viscosity grade produced by the Hercules Powder Company was priced at 36 cents per pound and this was well under our calculated maximum cost.

The high purity of CMC-CT grade, which averages 96.5%, entered into the consideration in selecting this material. Crude CMC which has been available in the past reportedly was not satisfactory for slashing because of the high salt content which often assayed as high as 35%.

EXPERIMENTAL

The first plant-scale experiments were conducted on 30/1 carded warp yarn made up on beams with a total of 5,000 yards. One-half of this yardage was slashed with a size solution of 5.5 percent CMC, while the remainder was sized with a 65:35 ratio of starch:CMC. The latter experiment was run to determine whether adequate reduction in pollution could be achieved at this degree of substitution. The fact that the 65:35 ratio does not require the use of enzymes for removal in desizing was the basis for the consideration of this particular ratio. The warps from these experiments were woven into 8-ounce pinwale corduroy. Time studies were made to determine weaving performance, in comparison with regular starch-sized warps. Weaving efficiencies of the experimental warps were equivalent to the regular work according to the time studies. It should be noted that these trials were made on conventional slashing equipment without modification in any manner.

TABLE III

COMPARISONS OF THE SIZE-SOLUTION SOLIDS AND WEIGHT OF SOLIDS ADDED ONTO THE YARN

Size Solution	*% Total Solids in Solution*	*% Added Weight on Yarn*
Carboxymethylcellulose	5.5	6.7
65:35, Starch: CMC	7.23	7.8
Regular starch formulation	11.7	13.7

It was observed that a lower solids add-on was maintained on the synthetic-slashed warps. This is shown in Table III. The lower solids on the sized yarn will, of course, reduce the cost of slashing with the synthetic formulation.

The fabrics woven from the experimental warps were processed by the finishing plant under careful observation. At the point of desizing, samples of the effluent from this operation were analyzed for their potential BOD. The desizing process normally requires the use of two five-compartment washer ranges in tandem. However, in this case, only one unit was utilized since CMC is water-soluble, and the starch-CMC size does not require enzyme extraction. Water and steam requirements were only half of that normally needed for good desizing. Hot water (180°F) overflowing from the five-compartment washer was sufficient for the straight CMC-treated fabric; however, ½% soda ash and ¼% sodium alkylarylsulfonate was used in the first compartment of the range in desizing the starch-CMC-combination-treated warps.

Table IV tabulates the BOD analysis of the effluent from the desizing range during processing of the experimental fabric as compared with the regular desizing process. The expected lowering of the BOD from use of the CMC slashing formula was realized; the reduction in the case of the starch-CMC samples is greater than the maximum calculated value of 67%. The reduction of 95% in this instance could be explained as due either to faulty BOD analysis or to an inhibiting factor contributed by the CMC.

An effort was made to determine the cause for the nonlinear reduction observed in the case of the starch-CMC effluent by laboratory analysis of various ratios of the two materials. Bacteria counts were made to determine if the CMC was acting as a bactericidal substance or whether the organisms were unable to attack the material. The carboxymethylcellulose is not toxic to microorganisms and could not account for the suppression of the BOD values. Figure 1 shows that almost any reduction in BOD can be obtained by the degree of substitution used and that the results will be practically linear. However, the calculated BOD is somewhat higher than the observed BOD for the CMC mixture as shown in Fig 2. This small difference may be due to the very low BOD of CMC and also because it retards the exertion of the BOD of the starch. It should be noted that all BOD determinations were run on 1,000-ppm solutions of the material tested; however, Fig 1 shows the effect of the 65:35 ratio of starch:CMC at 500 ppm concentration which would simulate more closely the concentration from the desizing effluent under normal operating conditions. From these analyses, it may be concluded that the nonlinear results from the starch-CMC effluent was due to faulty BOD analysis, since the starch had been completely removed from the fabrics.

Further investigations into other materials exhibiting low BOD values are currently under way. The preliminary results of the first slashing experiments seem to warrant continuation of these studies; therefore, 30,000 additional yards of yarn slashed with the 65:35 starch-CMC formulation are now in process.* The chemistry of various starch derivatives is being studied to determine their relationship to biochemical oxidation along with other available synthetic compounds.

* Since this paper was presented, the 30,000-yard experiment has been completed with the 65:35 ratio of starch and CMC. The efficiency was increased 4% by the use of that formulation for slashing over the old one. The BOD reduction averaged 80%, but this is still not so good as had been expected. No explanation of this is offered. The chemical cost for slashing was increased only about one dollar per thousand yards, and this has to be set against the cost of amortizing a treatment plant.

Another 30,000-yard experiment is now being conducted with different yarn sizes.

TABLE IV

COMPARISONS OF EFFLUENTS FROM DESIZING FABRIC SLASHED WITH CARBOXYMETHYLCELLULOSE, STARCH, AND STARCH-CMC COMBINATION

Effluent	*CMC*	*65 Starch : 35 CMC*	*Starch*
BOD ppm	47.5	36.6	385
Water temperature °F	185	185	185
Water consumption gallons/shift	54,000	54,000	108,000
BOD lb/8-hour shift	21	16.4	342
Percent reduction	93.5	95.3	

DYE WASTES

The dyeing process, which represents the second major source of pollution, will be discussed briefly to show how additional reduction in pollution can be made.

In this process large quantities of acetic acid are consumed, and this results in high BOD loadings when discharged to the receiving stream, either as acetic acid or its salts. The BOD of acetic acid, 56%, is 540 ppm on a 1,000-ppm solution; ie, it has a BOD of 0.54 pounds per pound of acid. The calculated BOD due to acetic acid represents 22 percent of the total pollution load coming from the finishing plant. Substituting mineral acids for acetic acid in various dyeing processes is one means of eliminating this source of pollution. Ammonium chloride and ammonium sulfate may also be used in simultaneous neutralizing and oxidizing of vat and sulfur colors in conjunction with sodium bichromate. Twenty percent reduction in this process, plus 45 to 50% reductions in desizing, would be sufficient in many instances to eliminate the need for treatment facilities.

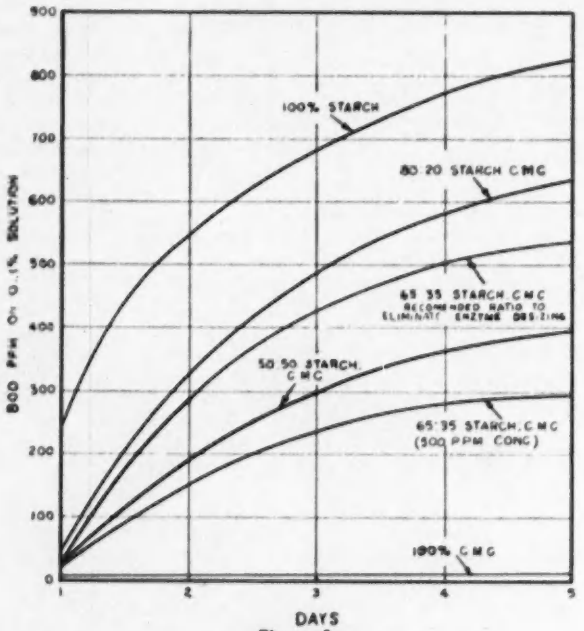

Figure 1

BOD exerted by 1000-ppm solutions of various ratios of starch and CMC

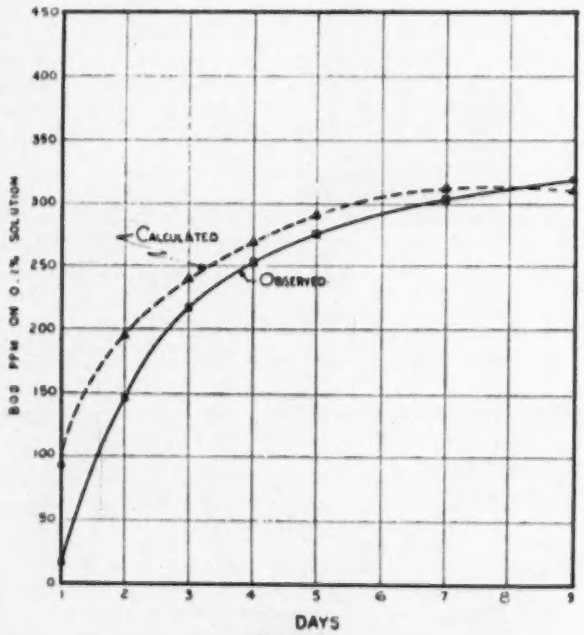

Figure 2

Calculated vs observed BOD of 65:35 starch to CMC

CONCLUSIONS

The preliminary results of the first slashing experiments suggest that additional experimentation is warranted. The economics of the system is definitely positive, since the additional costs for the substitute materials are not greater than the savings realized. The experimental data show that any degree of BOD reduction desired can be obtained by the extent of substitution made in the slashing formula.

The BOD load contributed by the combined desizing and dyeing operations represents 89% of the total produced. It is probable that this pollution can be reduced to the extent that only 30% of the total pollution now discharged will remain. If this can be accomplished, the need for treatment facilities will be unnecessary. This excludes, of course, the need for sedimentation of dye waste for the removal of color lakes, which would normally settle out on the bottom of the stream. Color lakes are a psychological nuisance, and they also inhibit the normal bottom life in a stream.

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ACKNOWLEDGMENTS

Acknowledgments of appreciation are extended to the following persons for their co-operation, information, and assistance: E H Crosse, Dan River Mills, Inc; Harold Jenkins and L M Wise, Hercules Powder Company; H A Pickford, Crompton-Highland Mills, Inc; and John S Brice, Penick and Ford, Ltd. Also, to American Cyanamid Co, E I du Pont de Nemours & Company, Inc, B F Goodrich Chemical Co, Monsanto Chemical Co, and Rohm & Haas Co, who are investigating the application of synthetic film-forming materials to cotton warps alone and in conjunction with natural products.

BLEACHERY AND DYEHOUSE WASTE STUDIES

JOHN L BROWN, JR
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A two-year study of the waste produced in the bleachery and dyehouse has been completed. Pilot-plant operation is planned to determine the most economical treatment and design factors for construction purposes.

The principles involved, based on analysis of the laboratory studies, will be

1) **Segregation of the waste into three components;**
2) **Storage of two of these components;**
3) **Blending of the three components and domestic sewage in proportions that are suitable for biological treatment.**

The results of the two-year study and the theoretical pilot-plant operation are discussed.

INTRODUCTION

THE North Carolina Stream Sanitation Law was passed in 1951. With the passage of this law, industry in North Carolina realized that its waste treatment problems must be solved. Until this time very little had been done on specific problems of waste treatment for the textile industry in North Carolina. A general knowledge of treatment methods for textile wastes was available, but, as we all know, each waste is different. Treatment methods will vary just as production methods vary throughout the industry.

Shortly after the passage of the Stream Sanitation Law, the management of Cannon Mills Company decided to make a study of the waste being produced at Kannapolis, North Carolina. H G Baity of Chapel Hill was employed as a consultant, and he made a preliminary study of our waste problem in April 1952.

The waste being produced at Kannapolis comes from four sources, namely: continuous peroxide and chlorine bleaching, continuous vat dyeing of woven goods, finishing of these goods and slasher-room waste. At present all of the waste, with the exception of the slasher rooms, empty into a common drain.

Dr Baity submitted a preliminary report in May of 1952. In this report, he recommended a plan for a complete study of our waste problem. This plan consisted of three basic steps:

1) Reduction of the strength and volume of the waste by means of recovery of salvageable materials and the re-use of cleaner wastes in preliminary processes.

2) Laboratory analysis of all waste-producing operations in order to determine if segregation of the wastes would be beneficial.

3) Pilot-plant operation in order to determine design factors and the treatment method best suited to our waste.

IMPLEMENTATION OF PLAN

Baity's plan was put into effect during the summer of 1952. It was decided to make a complete laboratory analysis of all waste-producing operations first. The data obtained from this study would furnish the necessary information about the segregation of the waste and also afford information that would help in regard to the recovery of salvageable materials and the re-use of the cleaner wastes. I will not go into detail on this laboratory analysis, since I am sure that you are all familiar with this type work.

The results of this study revealed:

1) That standardization of processes in the bleachery would reduce the strength of the waste considerably. This has already been done and has reduced bleaching costs as well as reduced the strength of the waste.

2) That the re-use of the cleaner wastes in earlier steps in the bleachery was practical. This has also been accomplished and has reduced the water consumption in the bleachery by about 10%. A better bleaching operation is also obtained by this method.

3) That a great amount of heat could be recovered if fine screens were installed ahead of the heat exchangers. The cotton fibers and strings were clogging the heat exchangers, and very inefficient operation was the result. This has not been changed but will be included when the wastes are segregated. The cotton obtained can be sold as cotton waste.

4) That there is a sizeable quantity of water that can be treated and refiltered. The cost of this treatment is slightly above our present water-treatment costs; however, when waste-treatment costs are considered, it makes this refiltration program practical. This will be done in conjunction with the final solution of the waste-treatment problem.

From the laboratory analysis of all waste-producing operations it became apparent that segregation of the waste would be beneficial. We found that there were three general classifications into which segregation of waste could be made, and these are being made as follows:

The No. 1 classification, which can be identified as *acid waste*, is composed of the waste produced in our desizing operations and in the slasher rooms. It contains chiefly starch, which decomposes very rapidly. It constitutes about 16% of the total volume of waste being produced and contains 53% of the BOD, 36% of the total solids, and 6% of the total alkalinity.

The No. 2 classification can be identified as *strongly alkaline waste* and is composed of caustic solutions and impurities that are washed from the goods before bleaching. It has a very high pH and can be held in storage without any great change in characteristics. This waste amounts to about 19% of the total waste by volume and contains 37% of the BOD, 43% of the total solids, and 60% of the total alkalinity.

The No. 3 classification can be identified as *mildly alkaline waste* and is composed of the waste from all the washing, bleaching, dyeing and finishing operations that are not included in the first two classifications. This waste amounts to about 65% of the total waste by volume and contains 10% of the BOD, 21% of the total solids and 34% of the total alkalinity.

From these figures it is apparent that 90% of the BOD, 79% of the total solids, 66% of the total alkalinity and 35% of the volume are concentrated in the first two classifications.

It is our plan to operate a pilot plant on our waste. Three pipe lines have been installed to the site of our treatment plant. Operation of the pilot plant will begin as soon as the necessary segregation of the waste in the bleachery and dyehouse can be accomplished.

The general scheme of our treatment will be a first-stage treatment for the first two classifications of our industrial waste. Then a final treatment on the effluent from this first-stage treatment combined with the remaining industrial waste and our domestic sewage.

The pilot plant study will involve

1) Storage of the *acid waste* and the *strongly alkaline waste*.

2) Blending of these two wastes through a settling tank and a filter or filters.

3) Combining this filter effluent with the *mildly alkaline waste* and the correct proportion of domestic sewage. Then treatment of this combination through a

second-stage treatment similar to that in our present sewage-treatment plant.

In the storage of the *acid waste* the starch settles very rapidly, and removal of the settled material from the storage tank will be necessary. The pH drops very rapidly to about 5.0 over a period of 16 hours. The storage of the strongly alkaline waste will not be a problem. It has a pH in excess of 12.0, and very little change occurs over a period of 7 days. It is planned to agitate this tank if necessary so that no settling will occur.

The storage of the first two classifications of our waste will allow seven-day operation of the plant, which will be beneficial in several ways. A blend of the two wastes after storage in about equal proportions produces a waste with a pH of around 9.5, and the solids settle very rapidly. After settling the waste will go to a high-rate filter or to filters with recirculation of filter effluent. The recirculation ratio and filter loadings will be varied in order to determine design factors. It may be necessary to recirculate a small part of our domestic sewage-filter effluent through the first-stage filter for seeding purposes. The design of the pilot plant will be such that any type of operation can be tried. We are planning to operate the pilot plant for a twelve-month period or longer if necessary.

The final design of our waste-treatment plant will be based on the data obtained from the pilot-plant operation. We feel that filter loadings greatly in excess of those that are in use for domestic sewage can be used.

Our present domestic sewage plant consists of primary settling, low-rate trickling filters, secondary settling, chlorination, and separate sludge digestion. This plant will be incorporated in the design of the second-stage treatment. The filters will be converted from low rate to high rate with recirculation. All of this is dependent upon the data obtained from the pilot-plant operation. However, from the laboratory results we feel that the method of treatment is sound, and the pilot-plant operation will furnish the necessary design factors.

CONCLUSION

A thorough study of an industrial waste is necessary, if the most efficient and economical treatment of waste is to be obtained.

TEXTILE-WASTE TREATMENT IN TEXAS

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INTRODUCTION

EARLIER this year Mr Souther expressed his interest in the work our Department had done several years ago in attempting to aid a member of your Industry in developing a process for the treatment of textile-mill waste. He later invited us to present a summary of these activities to this meeting, since he thought our findings and observations might be of some value to this group. You may be assured, we are most happy to submit our small contribution and we sincerely hope it might aid in any further studies which might be undertaken.

Since these events occured some 15-20 years ago and are more or less a matter of history, we will divert from our usual ambiguous type of presentation. We believe that any production figures which might be revealed are sufficiently obsolete to be harmless for disclosure at this time. In this connection we would like you to reflect for a moment upon the economic and social conditions of the Nation during the time of these studies—roughly from 1935 through 1940. These days of the WPA, the PWA, relief, keen competition for jobs, no serious water shortage, no National recognition of the stream pollution problem, the general status of industrialization of the South and Southwest. A comparison of those days and the present is most interesting, particularly with reference to a subject such as is under discussion at this meeting.

This paper presents a brief and condensed report on the activities of the Texas State Department of Health, Engineering Division, in studying the wastes of a textile mill and in determining various methods of treating these wastes so as to render them suitable for discharge into the municipal sewerage system. This work was done several years ago at the request of the industry since the mill wastes were reportedly having a detrimental effect upon the local domestic sewage treatment plant.

PROBLEM OF TEXTILE WASTE AT McKINNEY, TEXAS

With this in mind, then, and without going into all the many details of events which lead up to these studies, we will attempt to present a chronological report of our activities at the Texas Textile Mill Plant at McKinney in trying to determine an efficient and economic method of waste treatment. The City of McKinney is located some 32 miles north-northeast of Dallas. Population: (1920) 6,677; (1930) 7,307; (1940) 8,555; (1950) 10,525. It is the county seat of Collin County and is primarily an agricultural center. The textile mill is its largest industry. The city is situated on a ridge, with the west portion drained by Wilson Creek and the east side drained by the Trinity River. The city was served by a privately owned sewerage system comprised of a west- and an east-side sewage-treatment plant. The mill was discharging its wastes into the east-side system. Essentially, our studies were initiated in an effort to determine some type of treatment which would permit the sewage plant to receive and treat the industrial waste without materially affecting the operating efficiency of the plant.

In January, 1936, P J A Zeller, research associate of Texas A & M College, submitted a report and recommendations as a result of his studies of samples of waste submitted to him. He concluded that the waste "can be properly coagulated by a dose of 25 grains per gallon of commercial copperas. Coagulation can likewise be accomplished by a dose of 5 grains of copperas and 15 grains sulfuric acid per gallon." On the basis of information available to him he determined the cost of treatment would be $17.12 and $15.27 per month, respectively, to treat 725,000 gallons. Zeller also outlined his suggestions for a treatment process utilizing these chemicals.

Since the mill had its own underground water supply, accurate records of water use were not readily available. Consequently, in June of 1937 E H Pearl and the writer conducted rather extensive flow studies of the mill-waste streams and also conducted additional chemical-treatment tests. As a result of these studies it was reported that the wastes could be treated: 1) with sulfuric acid at a cost of $5.20/day for 66,000 gallons; 2) with acid and lime at a cost of $5.17/day for 66,000 gallons; 3) with copperas and lime for the raw-stock waste and acid for the indigo and indigo-wash waste for $4.10/day for a

total of 66,000 gallons. Treatment with alum, carbon, and chlorine were also tried but did not appear promising.

In December, 1938, J H Sorrels and G R Herzik, Jr, of our Department, working in our, then, almost-new laboratory trailer, conducted a hasty study in this area, which included additional tests on the mill wastes. Their report more or less substantiated the previous report with reference to treatment by control and change of pH of the waste by sulfuric acid. They also suggested that consideration should be given to the alternative use of alum to flocculate the colloidal color with rapid removal of the supernatant liquor to keep the color from returning.

Next followed a series of events, which ultimately resulted in the assignment of our mobile laboratory, under the direction of W C Gauntt, to the mill for an extensive study. This was a co-operative venture with officials of the mill, the sewer system, the County and the States participating in one way or another. The laboratory was parked on the mill site, and on September 26, 1939 the first phase of the study was initiated. This phase dealt with chemical analyses and measurements of volume of waste. The second phase related to possible treatment processes or procedures.

As will be noted from the tables in the Appendix, the wastes were grouped into four main categories according to source as indigo wastes, dyehouse wastes, finisher wastes, and slasher wastes.

With reference to the typical analyses of indigo wastes, we believe the observation noted under Table I of the variation in color intensity is worthy of consideration in treatment or disposal planning, although the treatability of this waste is evidently not too difficult. As will be noted in Table II, the relation of volume of waste to production is reported to be about 1 gallon of indigo waste to 2 yards of warp.

The dyehouse wastes are obviously the "roughest" wastes produced, and the method of operation is certainly one which would tend to present perplexing problems in the development of a simple treatment process. In Table IV the volume of waste is reported as slightly more than 7 gallons of waste per 1 yard of warp.

Tables V and VI report the results of the analyses of finisher and slasher wastes, indicating them to be relatively strong even though small in volume in comparison with other waste streams. However, the statement to this effect in paragraph D (page P389) should not be construed to imply that these could be neglected in the consideration of treatment or disposal plan. It is entirely possible that, under some conditions, these wastes might prove troublesome.

Table VII is merely a composite of Tables II, IV, V, and VI with an additional observation of domestic sewage contributed by mill employees.

The results of the second phase of this study are presented in Table VIII and the associated comments. Although the space devoted to the presentation of these findings is small, you may be assured that this phase of the investigation was the most time-consuming, actually some 10,000 tests were made. For those who might be interested a description of some of the treatment units used in these studies is as follows:

Sand Filter, a 4" vitrified clay sewer pipe having 13" of gravel (1" to ¼") followed by a 4" layer of coarse sand.

Stone or Trickling Filter, a 3" diameter iron pipe 79" in length filled with stone ¾" to 1½" to a depth of 66".

Carbon Filter, a 1¼" diameter glass tube 17" in length filled with activated carbon (commercial type, 4/10 mesh).

Aeration Process, a large acid bottle with rock passing ¾" mesh to a depth of 2½". Inside diameter of bottle, 4½". Oxygen supplied by creating a vacuum by aspirator on an air outlet and maintaining free entrance of air through a glass tube opening under rock. This constituted "contact aeration"; without the rock it was "plain aeration".

It will be noted that the results of tests on some of these units are not included in the Appendix, the reason being that the removals obtained were not so encouraging as the processes reported, and there was some difficulty in obtaining satisfactory operation of the units over a period of time. The conclusion drawn from this study is as follows:

"It was found that the most suitable treatment for indigo wastes was ferric sulfate 160 ppm plus lime 340 ppm and the cost per week per 369,000 gallons per 780,000 yards of warp would be approximately $14.87. For sulfur dye wastes with a weak formula (No. 65 Gray) the cost per week per 453,000 gallons of waste per 61,000 lbs cotton processed would be approximately $77.58 using copperas 800 ppm and lime 2000 ppm. Whereas for the stronger sulfur dye wastes (as No. 12 Black) the cost per week per 453,000 gallons of waste per 61,000 lbs cotton processed would be approximately $224.78 using ferric sulfate 1600 ppm and lime 3200 ppm."

The project was terminated on April 26, 1940, exactly 7 months after its initiation. The report was submitted to all interested parties with the recommendation that a pilot-plant study be initiated whereby these laboratory findings could be pursued further. Suggested plans for such a plant were developed and also submitted.

In May of 1940 we received a letter from Thomas E Craig, president of the Texas Textile Mills, presenting a preliminary report of an experiment in treating dye waste. In collaboration with our Mr Gauntt, a lagoon 50' by 50' was created by excavating to a depth of about 1' and forming a dyke around the edges with the excavated material. Into this lagoon was pumped "about one foot of our blackest and strongest surface-dye waste . . . so dark (as) to have been opaque to any ordinary light at a depth of one inch." The waste was retained for about one month with no additional waste being added. During the month there was an 8" rainfall and seepage losses were estimated at about 6". Hydrogen sulfide odor was never very pronounced, and clarification was noted as remarkable. We regret we do not have further information of any additional studies which might have been conducted along this line.

Although there was some additional activity to continue work on this problem, World War II put an abrupt end to any such plans.

In 1948 or 1949 the City of McKinney purchased the sewerage system, and in recent years there has been considerable improvement in the maintenance and operation of the treatment plants. The city has been considering plans to concentrate the sewage flow into a central treatment plant and hopes to provide treatment capacity for the mill waste. Their consulting engineers have developed a plan whereby, in their opinion, seeding the mill waste with domestic sewage, adequate stabilization can be obtained with the use of oxidation ponds. Such ponds—there are some 180 municipalities in Texas using oxidation ponds of some type as a means of obtaining secondary treatment—rely upon biological life which oxidizes the organic matter in the waste and produces a very stable effluent. We are not at liberty to discuss details of the proposed treatment process, as the engineers would prefer to wait until actual operating data can be presented. The construction of Lavon Dam (a 105,000-acre-foot-capacity reservoir) on the Trinity River in the vicinity of McKinney is prompting the improvement of many waste-treatment plants, as the water from this impoundment will be used extensively over a vast area for municipal and industrial purposes.

In conclusion, we wish to express our appreciation to the officials and employees of the Texas Textile Mills for their interest, co-operation, and active participation in these studies. We sincerely hope this report might, in some way, aid other investigators interested in this field.

APPENDIX

("Textile-Waste Treatment in Texas")

A) INDIGO WASTES——These wastes originate from the dyeing of chain warp for making blue denim (overalls). These wastes are weak, and they respond relatively easily to treatment processes. The wastes consist largely of caustics, artificial indigo dye and sodium sulfite. The greater part of the wastes comes from the final rinsing process where the warp passes through a series of three rinse vats continuously operated. The resulting waste is clear blue in color and amounts roughly to 50% of the weekly plant wastes; this of course depends on current dyeing and production schedules. A similar but weaker waste is produced (less often) when "copen blue" (a lighter shade) is dyed.

TABLE I

ANALYSES OF INDIGO WASTES

5-Day BOD	O_2 Consumed @ 25° C	O_2 Consumed Total	Alkalinity Carbonate	Alkalinity Bicarbonate	Chlorides	Solids Suspended	Solids Total	Color Intensity	pH	Temp ° C	Source of Sample
120	..	138	280	720	56	40	2070	600	9.7	35.0	Indigo Process Rinse
237	55	80	400	566	30	22	2462	540	9.4	32.0	Indigo Process Rinse

Later in these investigations, the color intensity was more often around 900; this will vary due to a change in the rate of rinsing or a change in the dye formula.

In all analyses of suspended solids and total solids, contribution is made by stray small cotton fibers. Alkalinity and chlorides may often be high, due to the use of caustic and sodium chloride in the dyeing processes.

TABLE II

INDIGO WASTES——RELATION OF VOLUME OF WASTES TO PRODUCTION (AVERAGE)

Average 5-Day BOD	pH	Color	Per Hour Gallons Waste	Per Hour Warp Yds Production	Per 24 Hours Gallons Waste	Per 24 Hours Warp Yds Production	Per Week Gallons Waste	Per Week Warp Yds Production	Population Equivalent
175	9.7-9.8	600-900	6,395	13,514	153,500	324,336	369,000	780,000	2,065

B) DYEHOUSE WASTES——Wastes from the dyehouse are made up of spent dye-vat liquors and wash water. Whereas other wastes are from continuous processes, these are from the batch type of operation. Approximately 132 different dye formulas are employed roughly grouped as follows: Sulfur dyes, bleach, naphthol dyes, and direct dyes. The amount, strength and character of the dyehouse wastes vary widely according to the production schedule, type of dye process and strength or shade of dye used. These dye wastes are relatively strong, and are much more difficult and expensive to treat than the wastes from the indigo process.

TABLE III

ANALYSES OF VARIOUS WASTES FROM RAW-STOCK PROCESSES IN THE DYEHOUSE

5-Day BOD	O_2 Consumed @ 25°C	O_2 Consumed Total	Alkalinity Carbonate	Alkalinity Bicarbonate	Chlorides	Solids Suspended	Solids Total	Color Intensity	pH	Temp ° C	Source of Sample
305	86	101	564	522	582	30	4600	..	9.5	22.5	Collection basin (indigo not running).
652	412	580	800	420	450	174	10976	4900	9.6	42.5	Collection basin (indigo not running).
370	..	211	200	1200	1340	130	5914	..	..	45.0	Dyehouse-effluent naphthols.
145	22	47	152	632	924	40	5800	..	8.7	37.5	Dyehouse-effluent naphthols.
344	190	295	264	378	106	28	3636	..	9.3	40.0	Dyehouse-effluent naphthols (sulfur dyes).
1320	4280	5400	color interference		13600	748	5622	42000	..	86.0	Spent sulfur dye from vat.
50	60	85	120	420	3530	14	1466	1800	8.8	36.5	Rinse of preceding process.
824	176	715	40	720	13600	134	2060	14100	7.4	85.5	Spent direct dye from vat.
33	1	11	100	380	1400	32	3618	85	8.6	37.5	Hot water plus NaCl recirculated in preceding process.

TABLE IV

DYEHOUSE WASTES——RELATION OF VOLUME OF WASTES TO PRODUCTION (AVERAGE) (RAW-STOCK COTTON PRODUCES)

Average 5-Day BOD	pH	Color	Per Hour Gallons Waste	Per Hour Warp Yds Production	Per 24 Hours Gallons Waste	Per 24 Hours Warp Yds Production	Per Week Gallons Waste	Per Week Warp Yds Production	Population Equivalent
285	9.2	5000	3779	509	90,696	12,218	453,000	61,000	2,067

C) FINISHER WASTES———This waste originates in the weave shed from the process of passing woven goods through a vat containing a sizing solution of starch gum and sugar in water; the cloth is then dried and calendered between heated metal cylinders.

TABLE V

ANALYSIS OF FINISHER WASTE

5-Day BOD	O_2 Consumed @ 25°C	O_2 Consumed Total	Alkalinity Carbonate	Alkalinity Bicarbonate	Chlorides	Solids Suspended	Solids Total	Color Intensity	pH	Temp ° C
1254	266	1831	0	1120	216	1390	21980	2500	7.3	94.0

D) SLASHER WASTES———In this process, the threads for warp are passed through a hot solution of sizing (composed of starch and warp size in water) to stiffen the warp strands in order to facilitate weaving. The waste is very similar to that from the finisher. Though both the slasher and finisher wastes had a very high BOD, they were so small in volume (compared with other wastes) that their separate treatment was not considered.

TABLE VI

ANALYSIS OF SLASHER WASTE

5-Day BOD	O_2 Consumed @ 25°C	O_2 Consumed Total	Alkalinity Carbonate	Alkalinity Bicarbonate	Chlorides	Solids Suspended	Solids Total	Color Intensity	pH	Temp ° C
1254	64	2244	0	440	260	..	88550	1000	7.3	93.0

TABLE VII

COMPOSITE TABLE———RELATION OF VOLUME OF WASTES AND STRENGTH TO PRODUCTION

Average 5-Day BOD	Color Intensity	pH	Per Hour Gallons Waste	Per Hour Production	Per 24 Hours Gallons Waste	Per 24 Hours Production	Per 24 Hours Population Equiv	Per Week Gallons Waste	Per Week Production	Type of Waste
175	600	9.7—9.8	6,396	13,514 yds (509 lbs raw stock)	153,500	324,336 yds	2,065	369,000	780,000 yds	Indigo
285	5000	9.2	3,779		90,696	12,218 lbs	2,067	453,000	61,000 lbs	Combined dyehouse
1254	100—2500	7.3	..	..	116	..	12	814	..	Finisher
1254	100—2500	7.3	..	..	..	..	..	70	..	Slasher
..	..	..	..	..	..	..	350	66,150	..	Domestic sewage

Total Population Equivalent per 24 hrs = 4,494

The second part of the study related to possible treatment procedures. Some 10,000 laboratory tests were made for all possible practical treatment processes. These included aeration, filtration with various media, chemical precipitation, and oxidation. A table of typical treatment results and expected costs follow (costs based on chemicals only in 1940).

TABLE VIII

TREATMENTS AND APPROXIMATE COSTS

Indigo Waste Treatment, ppm	Approx cost per thousand gallons	Percent color reduc	#65 Gray Waste (Weak Sulfur Dye) Treatment, ppm	Approx cost per thousand gallons	Percent color reduc	#12 Black Waste (Strong Sulfur Dye) Treatment, ppm	Approx cost per thousand gallons	Percent color reduc
Aeration	$0.0250	65%	Copperas 800 Lime 2000	$0.0915 0.0835	80%	Pre-aerated 2 hrs Ferric sulfate 1600 Lime 3200	$0.36103 0.13520 $0.49623	95.6%
				$0.1750				
Lime	$0.0338	65%	Pre-aerated 2 hrs Copperas 800	$0.0915 0.0751	85%	Alum 7000	$0.8470	99 %
			Lime 1800	$0.1666				
Ferric sulfate 160 Lime 340	$0.0261 0.0142 $0.0403	65%	Alum 2625	$0.3176	87%	Pre-aerated Alum 5500	$0.6655	99.3%
Alum 1200	$0.1452	65%	Pre-aerated 2 hrs Alum 2250	$0.2723	90%	Sulfuric acid 4410 Pre-aerated same	$0.9200	99.4%

BIOLOGICAL TREATMENT OF MIXTURES OF HIGHLY ALKALINE TEXTILE-MILL WASTE AND SEWAGE

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Pilot plant studies are being made on the treatment of mixtures of domestic sewage and textile-mill dye and finishing wastes by high-rate trickling filters, by activated sludge, and by chemical treatment to determine the most economical and most efficient method for treating such a mixture.

Contradictory to published reports stating that sewage and industrial wastes with high alkalinity cannot be successfully treated in an activated-sludge plant, results in this research indicate that pretreatment through a trickling filter and subsequent treatment through activated sludge is the most efficient method and can be satisfactorily used for treating highly alkaline textile wastes. An unusually high removal of BOD and color is obtained.

Certain process changes in the plant have also been made to reduce the BOD loading through the treatment plant.

INTRODUCTION

THE subject of treating textile waste has been a very controversial one. The literature states that highly alkaline wastes cannot be treated biologically with sewage in city systems without pretreatment *(1)*. Apparently those concerned with treating waste have accepted these statements as final, and have not tried or experimented with the treatment of wastes containing extremely high amounts of alkali without neutralization, coagulation, or such. Since this has been the case in the problem of treating our textile-mill waste combined with sewage in the city system, we have felt the urgency of making our own experiments to ascertain the true facts on treatments of this type.

Results obtained are most encouraging and definitely show that wastes with a high alkalinity and pH can be successfully treated biologically without pretreatment, other than control of flow of waste to sewage. This paper will discuss our experiments to shed new light on this problem.

HISTORY

Cone Mills has been actively concerned for a long time with the successful treatment of textile-mill waste to abate stream pollution *(2, 3)*. It co-operated with the State Board of Health and the City of Greensboro in sponsoring the field laboratory of the Textile Foundation group, out of which came the outstanding research in textile wastes. This research has not been surpassed in its basic concepts for treating textile wastes, although it did not go far enough in treating highly alkaline wastes biologically *(4)*.

For many years prior to the work of the Textile Foundation, our company had treated its waste by various methods:

1) At Proximity Plant, denim-mill waste containing indigo and sulfur-dye waste was satisfactorily treated with calcium chloride, allowed to settle, and supernatant liquid was drained to the creek.

2) Dye and other textile wastes were aerated and sprayed on a hillside. In this method, the luxuriant growth of grass indicated that most mill waste was nontoxic.

On the basis of Textile Foundation studies, it was decided to build a municipal sewage-treatment plant to take care of the city's municipal sewage need. With this accomplished, the matter of the textile wastes was to be kept under study, and the city plant extended to take care of such parts of the wastes or such pretreated wastes as the studies indicated could be handled in a municipal sewage-treatment plant. This plant used the activated-sludge system of complete treatment for domestic sewage. Although the plan was to build the plant with a capacity to take care of the sewage from 65,000 persons, the design was for a capacity of 130,000, with only half of the units of settling basins, aeration tanks, and digesters for immediate construction. At the end of 10 years, or if it was found feasible to accept textile wastes at an earlier period, the plant was to be expanded by building the additional units as required.

Another important provision was included in the design for immediate construction. In order to handle any textile waste at such a plant, it would obviously be necessary to add chemical coagulants to the mixed sewage and wastes before treatment. Equipment was included to feed accurately the various coagulants that might be found suitable. The equipment also included flash mixers, coagulating basins, and other units essential to such treatment. This permitted the treatment of some of the textile wastes as far as the plant capacity would permit. The important purpose in adding such equipment was to permit a plant-scale study of the treatment of the various textile wastes and combination of these. The mills co-operated with the city in financing the cost of this equipment and in defraying the cost of coagulants. This same pattern has recently been followed in co-operating with the City of Salisbury in treating waste from our Salisbury plant.

It was reasonable to conclude that, before the ten-year period expired (estimated as the efficient life of the sewage-treatment plant), definite knowledge would be obtained toward answering the following questions:

1) What pretreatment would be required to make it possible for a municipal sewage-treatment plant to handle the ultimate disposal of sewage and textile wastes?

2) What additions and alterations would be required in the municipal plant to accomplish this?

3) If all or only part of the textile wastes cannot be economically treated by the municipal plant, what separate treatment will be required? (However, the plant has not been used for this purpose. It was felt by others, but not by us, that our waste was too highly alkaline to be treated in this plant, hence, the urgency of the experimental work in our laboratory to determine what needs to be done.)

The present plant started up in July, 1938, with part of the city sewage and later the full average 4.5 mgd (millions of gallons per day). Domestic sewage alone was admitted to the plant until January, 1939. After January, 1939, there

was no period when textile wastes were not admitted to the plant. The coagulants used were alum and sulfuric acid, which gave excellent results. In the year, July, 1939, to June, 1940, over-all reduction of BOD through the plant averaged 93.4%, and every single month showed a BOD reduction over 90%. During this period the plant was treating wastes from all of our mills, except one denim mill where the waste was being treated separately by the calcium chloride process. At this time also the acid was fed by manual control. It was decided to add the waste from the second denim mill, and instrument control was added to feed the acid automatically on demand of pH. Instruments often failed. Differing opinions of treating methods have led to this pilot-plant study to treat highly alkaline waste without the use of expensive chemicals *(5)*.

It was our opinion that the Textile Foundation research still pointed to the best plan of attack, and that the waste could best be treated by running combined alkaline mill waste and sewage through a roughing high-rate trickling filter, then by running the effluent through the activated-sludge units, which are now idle. A search of the literature failed to reveal that a 40-60% mill waste-sewage mix had ever been treated in biological processes at pH up to 11.5 without serious upsets. The City of Charlotte, for example, will not accept waste above a pH of 9.0 in its new biological treatment plant. Our objective is to treat without acids or other chemicals and to save expensive chemical costs. The amount of waste to treat has already been reduced by using less chemicals in plant processes *(6)*.

PILOT PLANT

Accordingly, a pilot plant installation was set up in our laboratory to obtain information which could be used as a guide in making recommendations or accepting the recommendations of others.

The plan was to collect samples of textile waste and to mix it with sewage in the same proportions that would be used in actual treatment at the North Buffalo Plant. The essential units installed have been a mixing tank, a settling tank, a trickling filter, and an activated-sludge tank. In such an installation it was felt that information could be obtained to determine

1) Results of treating combined mill waste and sewage through both high-rate trickling filter and activated-sludge tank.

2) The efficiency of treatment of combined mill waste and sewage through a trickling filter alone.

A) High-Rate Trickling-Filter Treatment is a process whereby the waste to be treated is spread in a spray or as a thin sheet over a bed of stone and allowed to trickle down through the stone into an underdrain system, where the treated waste is collected and discharged. The principle of waste treatment with a trickling filter is based on the development of a gelatinous film of bacteria on the surface of the stone in the filter. As the waste trickles over this film of bacteria, these organisms oxidize and stabilize the organic material in the waste. The air in the spaces between the stones provides oxygen for aerobic bacteria to do their work.

There are two classes of trickling filters: standard-rate and high-rate. In general, a standard-rate trickling filter is one in which the waste flows through the stone bed one time, while a high-rate trickling filter is one in which the waste may be recirculated through the stone bed more than once. The actual difference between these two types of filters is in rate of waste application and organic loading. In simple terms, a high-rate trickling filter has a larger volume of waste fed onto a unit surface area in a given time, and a higher organic loading (larger BOD) fed onto a unit filter volume in a given time, than does a standard-rate trickling filter. It is thus seen that it is more desirable to treat a strong waste on a high-rate trickling filter than on a standard-rate trickling filter *(7)*.

The high-rate trickling filters are further subdivided into two types:

1) biofilter and accelofilter, which use continuous recirculation through the filter as their basic feature;

2) the aerofilter, using a continuous rain-like application of the waste to the filter as its main feature.

The type used in this experiment does not exactly fall into either group. It is designed to use continuous recirculation of 2 to 1 and a rain-like spray, caused by running the waste against the shaft and blades of an air stirrer. It is a combination of the best features of both.

1) A *single-stage high-rate trickling filter* is one in which the waste is treated on one or more filters but they operate in parallel.

2) A *two-stage high-rate trickling filter* is one in which there are always at least two filters, which operate in series. In other words, the waste goes through one filter and then through the other filter. The waste may be recirculated on either one or both filters.

The experiments mentioned in this paper are made with single-stage high-rate trickling filter, and other experiments are planned with two-stage or multiple filters.

B) Activated-Sludge Process is a method of mixing sewage or waste and sewage mixture with 20-35% of its volume of biologically active sludge, then agitating this mixture with air or in the presence of air, and allowing the suspended matter to settle. The clear liquor is drawn off and disposed.

The sludge is biologically active and contains a large number of aerobic and facultative bacteria. It is developed by continuous aeration of untreated sewage and sludge for a period of several weeks. The air is passed into the mixture in the form of small bubbles, which furnish oxygen for the bacteria. This process is called *activation*, and the resulting sludge, with its ability to oxidize organic matter is called *activated sludge*.

C) Combination of High-Rate Trickling Filter and Activated Sludge. The waste is first treated on a high-rate trickling filter, and the effluent from the trickling filter is treated in an activated-sludge aeration tank and then settled to remove the sludge.

D) Chemical Treatment includes coagulation of the waste by chemicals and then settling out of dyes and other material that will be easily removed. Then it may be given treatment through a high-rate trickling filter, through an activated-sludge tank, or released directly to drain.

PILOT PLANT EXPERIMENTS

A pilot-plant high-rate trickling filter was constructed in the laboratory. This plant was designed to have a flow from 50 to 150 gallons per 24 hours, based on the strength of the waste to be treated. The trickling filter was 15-inch terra cotta pipe (inside diameter), 4 feet long. The total volume of stone was 4.88 cu ft. The filter media consisted of granite chips broken into sizes ranging from 1½ to 3½ inches in diameter. The recirculation ratio was planned to be held constant at 2 to 1.

The plant was to be fed from a 150-gallon storage tank. First, the plant was operated with the storage tank mixed and allowed to stand with the pump intake operating from a float on the surface. BOD determinations were made on the new tank contents as soon as it was made up, 18-24 hours later another sample was taken, and also a composite sample was collected from 8 am to 4 pm. Catch samples were taken at 8 am and 12 noon, and the tank was mixed and pumping to filter started at 10 am.

From these BOD determinations it could be determined how much BOD would be lost on holding the mix, the strength of the waste after mixing, and the average BOD going to the filter. Later a mixer was added to the storage tank,

the pump intake was moved to the bottom of the tank, and the same series of BOD samples was collected. As the latter method proved more successful, it was made part of the design.

The waste is delivered to the pilot plant in 55-, 30-, and 5-gallon drums. The correct percentages of textile-mill wastes are pumped into a 55-gallon mixing tank. There they are mixed with a small electric mixer, the pH is checked, and a rough adjustment is made if necessary. The correct amount of sewage is then pumped into the 150-gallon storage tank after it has been drained of almost all of the mixture remaining from the day before (if there is any left), with just enough remaining to keep the pump intake covered (approximately 5 gallons). Once a week the tank is drained completely and washed out. Then the mixed mill waste is pumped from the mixing tank to the 150-gallon storage. If any remaining mill waste is needed, it is pumped direct to the 150-gallon storage tank. There the storage tank is completely mixed and final pH adjustment is made. A sample is taken for BOD.

The above procedure was followed as long as pH adjustment was necessary. When the point was reached where no pH adjustment was necessary, the mixing in small tank was discontinued, and the correct proportions of waste and sewage were pumped direct into the 150-gallon storage tank. After an hour's mixing, a new sample was taken for BOD determination. The correct flow is pumped direct from the storage tank onto the trickling filter without primary settling.

The incoming raw waste is mixed with the recirculated waste just before they both flow against the shaft and blades of an air stirrer. This serves to spread the mixture of raw waste and recirculated waste over the surface to the stone in the trickling filter in a fine spray or series of drops. As the waste flows through the trickling filter it is oxidized by the aerobic bacteria located in the gelatinous fiber on the surface of the stones. The waste then flows to a settling tank, which holds it for two hours. This is long enough for any converted settleable suspended matter to settle out. The waste then flows through the sump for the recirculation pump and out to drain as shown in Figure 1.

TABLE I

DATA: TREATMENT OF RAW SEWAGE THROUGH HIGH-RATE TRICKLING-FILTER PILOT PLANT (TO DEVELOP BIOLOGICAL GROWTH ON FILTER)

Date	Influent	Effluent	% Removed
2-11-54			
pH	6.9	7.5	
DO	0	2.4	
BOD, ppm	260	164	37
Flow, gpd	55	55	
Recirculation	2 to 1		
2-18-54			
pH	6.9	7.5	
DO	0	2.8	
BOD, ppm	288	23	89
Flow, gpd	55	55	
Recirculation	2 to 1		
3-4-54			
pH	6.8	7.2	
DO	0	4.6	
BOD, ppm	283	48	83
Flow, gpd	55	55	
Recirculation	none		

The pilot plant was started on raw sewage from the Bessemer line at Greensboro's North Buffalo Sewage Treatment Plant on February 9, 1954, at 55 gallons per day, or one-fourth of design capacity based on organic loading. It was run for 29 days on sewage alone, and the percent removal of BOD indicated that a good filter growth had been developed, even in 9 days (Table I).

After a good growth was established on the stone of the filter, a mixture of textile-mill waste was added in gradually increasing amounts with a corresponding decrease in the amount of sewage.

The textile-mill waste was composed as shown in Table II.

In the total of 11.21 mgd of city and textile-mill wastes, the mill waste totals are shown in Table III.

Therefore, in the 4.36 mgd of textile mill waste and in the 11.21 mgd total flow, there would be the percentages of waste from each outlet shown in Table IV.

The textile-mill waste was added to replace sewage in increasing percentages. It was started on 4% textile-mill waste and 96% sewage. This was continued, more of the textile mill waste being gradually added and the amount of sewage decreased until the ratio of 40% mill waste and 60% sewage was reached. Then the flow was increased to the full capacity of 125 gallons per day. This is the equivalent of mill waste in the total 11.21 mgd flow in the present total flow picture.

After the flow was increased to 125 gpd, it was still necessary to acclimate

TABLE II

TEXTILE-MILL WASTE

Plant	Type Waste	Sampling Stations
Plant 1	Sulfur and indigo	Outlet 1
Plant 2	Rayon and cotton dye waste	Outlet 2
	Finishing waste	Outlet 3
Plant 3	Bleachery and kier waste	Outlet 4
Plants 3 and 4	Kier and finishing waste, vats, sulfur, indigo, color shop, mercerizing wastes	Outlet 5

TABLE III

WASTE TOTALS

Sampling Stations	Total Waste mgd	BOD lb/day	BOD ppm
Outlet 1	0.212	1820	1028
Outlets 2 and 3	0.993		
Culvert—0.475 mgd		1510	381
Sump —0.518 mgd		2760	640
Outlet 4	0.144	2440	2040
Outlet 5	3.011		
Overflow to Creek—1.441 mgd		5900	490
To Plant —1.57 mgd		6420	490
Total Mill Waste	4.360	20,856	
Sewage	6.85	14,900	
Total	11.21	35,756	

TABLE IV

WASTE FROM EACH OUTLET

Outlet No.	Textile Waste 4.36 mgd %	Total Flow 11.21 mgd %
1	4.86	1.89
2	10.90	4.24
3	11.88	4.62
4	3.30	1.29
5	69.06	26.86
Total Textile Waste	100.00	38.90
Sewage		61.10
Total		100.00

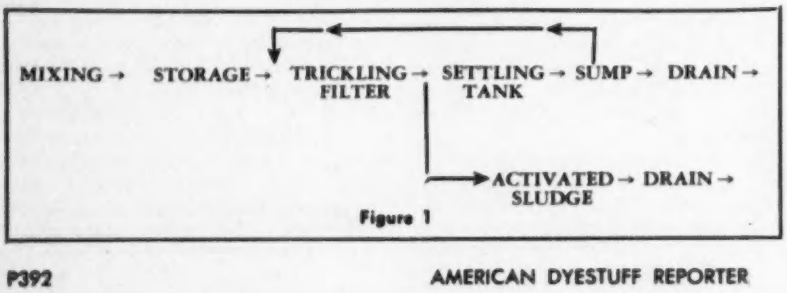

Figure 1

TABLE V

DATA: PILOT PLANT TREATMENT OF 40% HIGHLY ALKALINE MILL WASTE AND 60% SEWAGE WITH pH ADJUSTMENT———125 GPD———2:1 RECIRCULATION RATIO

	4-27-54	4-28-54	4-29-54	4-30-54	5-3-54	5-4-54	Average at pH 8.5
Influent to Pilot Plant—Raw Mix							
pH—Original	11.1	11.1	11.1	11.1	11.1	11.1	
—Adjusted to	8.5	8.5	8.5	8.5	8.5	8.5	8.5
BOD, ppm	560	510	575	530	525	355	509
Color, ppm	400	600	600	500	400	600	520
Effluent from Trickling Filter							
pH	7.5	7.6	7.4	7.5	8.0	7.7	7.6
BOD, ppm	280	160	153	192	113	124	170.3
Color, ppm	200	200	200	180	200	150	188
Effluent from Trickling Filter and Final Settling Tank							
pH	7.6	7.6	7.3	7.5	8.0	7.7	7.6
BOD, ppm	163	133	139	144	106	123	134.7
Color, ppm	200	200	200	175	200	150	187.5
Effluent from Activated Sludge							
pH	8.0	7.7	7.3	8.2	8.1	7.7	7.8
BOD, ppm	48	58	52	51	15	19	40
Color, ppm	60	80	70	70	80	60	70
% REMOVAL							
Through Trickling Filter							
BOD, %	55	69	73	64	79	65	66.5
Color, %	50	67	67	64	50	75	63.5
Through Trickling Filter and Final Settling Tank							
BOD, %	71	74	76	73	80	65	73.5
Color, %	50	67	67	65	50	50	64
Entire Plant—Trickling Filter and Activated Sludge							
BOD, %	92	90	91	90	97	95	92
Color, %	88	87	88	86	80	91	86.5

the filter to the higher pH. The pH had been controlled at 8.2 until the 40-60% mill waste-sewage mixture was reached. The pilot plant was then run for a while until it was positive that the filter was adjusted to the 40-60% mixture at 125 gpd and a pH of 8.2 (Table V). Thereafter, the pH was allowed to rise gradually to a point where no pH adjustment was necessary.

PILOT-PLANT RESULTS

The biological treatment of highly alkaline mill waste up to 40% mixed with sewage, with no chemical pretreatment, has proven very successful. Results indicate that even higher proportions of mill waste could be treated. The percent removal of BOD through the trickling filter and the activated sludge tank remained in the range of 90 to 96% throughout the period from July 7 to August 7, 1954 (Table VI). The pH of the mixture was reduced by treatment from 10.0-11.4, the pH range of the influent, down to 7.9-8.5, the pH range of the final effluent.

Suspended-solids removal was about 55% through trickling filter alone, and about 95% through trickling filter and activated-sludge tank (Table VII).

The total alkalinity of the waste mixture as it went through the pilot plant remained about the same, but the hydroxides and carbonates were gradually converted to bicarbonates by the trickling-filter and activated-sludge units (Table VIII).

A special experiment was run in which caustic soda was added after the pH reached 11.0 in an effort to see just how high the pH would go and how well the filter would treat the abnormally high alkaline mixture. It was found that an extremely large amount of caustic soda was required to raise the pH only a small amount. The critical pH appears to be between 11.3 and 11.4, at which point the efficiency dropped sharply but recovered in three days on normal waste and sewage (Table IX).

A short summary of the results of the added caustic follows:

TABLE VI

DATA: PILOT PLANT TREATMENT OF 40% HIGHLY ALKALINE MILL WASTE AND 60% SEWAGE NO pH ADJUSTMENT———125 GPD———2:1 RECIRCULATION RATIO

	7-8-54	7-9-54	7-14-54	7-15-54	7-16-54	7-21-54	7-22-54	7-23-54	8-5-54	8-6-54	Monthly Average
Influent to Pilot Plant											
Alkalinity (based on 11.2 million gallons)											
Total Na_2O in original waste											
pounds	46,891	46,237	45,303	42,968	40,539	50,907	66,787	42,220	69,029	69,496	..
%	0.0502	0.0495	0.0485	0.0460	0.0434	0.0545	0.0715	0.0452	0.0739	0.0744	..
Phenolphthalein Alkalinity, lbs Na_2O	26,902	15,599	23,824	22,044	21,484	32,039	43,435	23,168	44,369	41,660	..
pH	10.4	10.5	10.4	10.2	10.0	10.5	10.9	10.4	10.6	11.0	10.5
BOD, ppm	342	441	555	465	410	516	660	446	444	428	471
Color, ppm	550	600	500	600	650	500	600	800	600	600	600
Effluent from Trickling Filter											
pH	9.1	8.9	9.0	8.9	8.8	8.9	9.6	9.3	9.0	9.2	9.1
BOD, ppm	145	198	246	218	181	204	330	260	222	294	230
Color, ppm	300	300	300	350	400	400	300	400	350	350	345
Effluent from Trickling Filter and Final Settling											
pH	8.9	8.7	9.0	8.9	8.8	8.7	9.5	9.3	9.0	9.0	9.09
BOD, ppm	100	181	200	211	181	150	273	246	173	269	198
Color, ppm	300	300	300	300	400	350	300	400	350	350	335
Effluent from Activated Sludge											
pH	8.2	8.1	8.1	8.1	8.0	7.9	8.2	8.5	8.2	8.1	8.1
BOD, ppm	36	26	35	41	33	33	34	33.5	18	18	31
Color, ppm	200	200	150	300	200	200	200	200	140	140	193
% REMOVAL											
Trickling Filter and Final Settling—Based on Influent											
BOD, %	68.5	59	64	54.7	56	70.5	58.7	44.8	61	57	58.0
Color, %	45.5	50	40	50	31	30	50	50	42	42	44.1
Activated Sludge, Based on Effluent from Trickling Filter without Settling											
BOD, %	81	82	86	81	82	84	89.5	87	92.5	94	86.5
Color, %	33.3	33	50	14.3	50	50	33.3	50	69	60	44.1
Entire Plant, Trickling Filter and Activated Sludge											
BOD, %	90	93.5	93	91.2	92	93.5	95	91	96	96	93.2
Color, %	63.5	66.5	70	50	60	60	67	75	77	76.5	68

6/17/54 Based on flow 11.2 mgd, 12,000 lb $NaOH$ (9,300 lb as Na_2O) were added to 46,890 lb Na_2O present. pH raised 11.0 to 11.2. No appreciable effect was noticed.

6/18/54 Based on flow 11.2 mgd, 17,700 lb $NaOH$ (13,717.5 lb as Na_2O) were added to 61,369 lb Na_2O present. pH raised from 11.0 to 11.3. No appreciable effect was noticed.

6/22/54 Based on flow 11.2 mgd, 143,000 lb $NaOH$ (110,825 lb as Na_2O) were added to 45,957 lb Na_2O present. pH raised from 11.0 to 11.4. The efficiency dropped sharply but recovered in 3 days on normal waste and sewage.

Therefore, shock loads of waste high in caustic alkalinity do not completely upset the plant, and if this does not occur too often, the efficiency will not be adversely affected, because the trickling filter recovers rapidly. This may hold true, however, only if the plant is already adjusted to high alkalinity, and not for rapid change from and to high pH.

CONCLUSIONS

The results of these pilot-plant experiments thus far have led to the following conclusions:

1) Contrary to published data, it is indicated that a mixture of up to 40% highly alkaline composite dyehouse, bleaching, finishing, mercerizing, and color-shop mill waste with 60% domestic sewage can be successfully treated with no chemical pH adjustment.

a) *Through high-rate trickling filter and activated sludge.*

Efficiencies of about 93% removal of BOD were obtained through these units with no adverse effects due to highly alkaline nature of waste. The highly alkaline nature of the waste tended to keep sulfide odors from coming off through the treatment processes.

b) *Through trickling filter and settling only.*

Good BOD removal for this type of waste was obtained through trickling filter and final settling. Efficiency, or BOD removal, at influent pH 8.5 is about 73%, and at pH 10.5 about 58%.

2) The success of the treatment of this highly alkaline mill waste and sewage mixture with pH of 11.4 and over was due to the extreme care used in gradually acclimating the filters and the activated sludge to the highly alkaline waste.

3) Efficiencies above 90% in the removal of objectionable organic-odor-producing substances are obtained up to pH 11.4 through the bio-filter aeration system but a gradual drop occurs above pH 11.4. The drop in efficiency was due to the high concentration of alkali which only raised the pH slightly. Strong slugs of highly alkaline waste added experimentally did not knock the filter out. The efficiency dropped some but picked up rapidly.

4) Good color-removal results were obtained from treating the 40-60% mill waste-sewage mixture at high pH through the combined filter-aeration process. The resulting effluent was as good as the effluent obtained from the trickling filter alone when the pH was adjusted to 8.5. It was clear with only a slight yellow tinge, a great improvement over the dark blue-grey color of the original influent mixture.

5) The final effluent had no odor. Also no odors were noticeable at the various units of the plants, as may be noticed if the treating pH is below 7.0. The fact that the pH of the 40-60% mixture never dropped to 7.0 or below seems to be a controlling factor in odor control. If the pH on the trickling filters had dropped below 7.0, objectionable odors may have been formed.

FUTURE EXPERIMENTS

The addition of a second filter to make the pilot plant a two-stage trickling-filter activated-sludge plant has been accomplished, and the first few results indicate the total BOD removal may reach 96% and color removal 80%, with an effluent from the final unit very clear.

Other experimental work includes the effect of storage on pH, activated-sludge treatment of highly alkaline waste, and special treatment of denim-mill waste. Another experiment suggested by the

TABLE VII

DATA: ANALYSIS OF WASTE THROUGH PILOT PLANT (NO PRETREATMENT WITH CHEMICALS)

	Influent Pilot Plant	*Off Trickling Filter*	*Out Final Settling Tank*	*Out Activated-Sludge Tank*
pH	11.1	9.8	9.8	8.3
Color, ppm	600	300	300	200
Chlorine Demand, ppm	56	36	36	15
Total Alkalinity as Na_2O, %	0.0477	0.0472	0.0477	0.0446
Carbonates as Na_2CO_3, %	0.0785	0.0425	0.0382	0.0085
Bicarbonates as $NaHCO_3$, %	0	0.0303	0.0345	0.0470
Hydroxides as NaOH, %	0.0025	0	0	0
Redox	+180	+145	+150	+45
Dissolved Oxygen, ppm	0	0	0	2.5
BOD, 5-day, ppm	414	200	165	38
Total Solids, ppm	1879	1681	1640	1434
Volatile Solids, ppm	512	327	308	148
Fixed Solids, ppm	1367	1354	1332	1286
Total Suspended Solids, ppm	102	36	46	4
BOD Removal, %			60	90.6
Suspended Solids Removal, %			54.8	95.6

TABLE VIII

DATA: EFFECT OF PILOT PLANT ON ALKALINITY

	Incoming Raw Mix	*Off Trickling Filter*	*Out Final Settling Tank*	*Out Activated Sludge*
7-16-54				
8 am				
% Total Alkalinity as Na_2O	0.0485	0.0460	0.0453	0.0422
% Carbonates as Na_2CO_3	0.0595	0.0255	0.0255	0.0085
% Bicarbonates as $NaHCO_3$	0.0815	0.0420	0.0412	0.0503
% Hydroxide as NaOH	0	0	0	0
4 pm				
% Total Alkalinity as Na_2O	0.0434	0.0435	0.0460	
% Carbonates as Na_2CO_3	0.0700	0.0740	0.0600	
% Bicarbonates as $NaHCO_3$	0.0034	0	0.0118	
% Hydroxide as NaOH	0	0	0	
7-22-54				
8 am				
% Total Alkalinity as Na_2O	0.0533	0.0510	0.0502	0.0460
% Carbonates as Na_2CO_3	0.0690	0.0605	0.0530	0.0042
% Bicarbonates as $NaHCO_3$	0	0.0210	0.0260	0.0588
% Hydroxide as NaOH	0.0084	0	0	0
4 pm				
% Total Alkalinity as Na_2O	0.0715	0.0600	0.0557	
% Carbonates as Na_2CO_3	0.0425	0.0915	0.0740	
% Bicarbonates as $NaHCO_3$	0	0.0093	0.0168	
% Hydroxide as NaOH	0.0280	0	0	

TABLE IX

DATA: PILOT PLANT TREATMENT OF 40% HIGHLY ALKALINE MILL WASTE AND 60% SEWAGE——— EFFECT OF ADDING EXTREMELY HIGH AMOUNTS OF CAUSTIC SODA TO PRODUCE HIGH SHOCK LOADS
125 GPD———2:1 RECIRCULATION RATIO

	6-17-54	6-18-54	6-22-54	6-23-54	6-25-54	6-30-54	7-1-54	7-2-54
Influent to Pilot Plant								
Alkalinity (based on 11.2 million gallons)								
Total Na_2O in original waste, pounds	46,890	61,369	45,957	88,644	49,226	53,896	38,764	43,995
%	0.0502	0.0657	0.0492	0.0949	0.0527	0.0577	0.0415	0.0471
Phenolphthalein Alkalinity, lb Na_2O	27,275	34,561	23,165	51,561	29,610	28,956	20,923	10,368
Added NaOH, lb	12,000	17,700	143,000	...	...	...	...	...
pH—Original	11.0	11.0	11.0	11.4	10.9	10.9	10.9	10.5
pH—after adding NaOH	11.2	11.3	11.4	...	...	...	...	...
BOD, ppm	424	353	300	395	487	418	426	405
Color, ppm (APHA)	450	425	400	600	600	400	400	400
Effluent Trickling Filter								
pH	9.4	9.4	9.8	11.0*	9.4**	9.6	9.2	9.4
BOD, ppm	207	146	187	316	219	227	148	188
Color, ppm	240	200	200	400	400	200	250	300
Effluent from Trickling Filter and Final Settling								
pH	9.3	9.4	9.5	11.0	9.4	9.4	9.2	9.3
BOD, ppm	87	416	131	316	258	214	148	186
Color, ppm	240	200	200	400	400	200	200	275
Effluent Activated Sludge								
pH	8.3	8.5	8.2	9.6	8.5	9.0	8.8	8.7
BOD, ppm	30	53	21	177	63	99	102	86
Color, ppm	120	100	150	200	300	200	200	250
			% REMOVAL					
Trickling Filter and Final Settling, Based on Influent								
BOD, %	56	58	56	19.8	47	49	65	53.5
Color, %	46.7	53	50	33.3	33.3	50	50	45
Activated Sludge, Based on Effluent from Trickling Filter Without Settling								
BOD, %	88	75.5	87	5	78	60	55	41.8
Color, %	52	58	25	0	25	33	0	0
Entire Plant—Trickling Filter and Activated Sludge								
BOD, %	92.5	85	93	55	86.5	76.5	76	78.8
Color, %	73	76.5	62.5	66.5	50	50	50	50

* Extremely high alkali cut growth on top layer of filter rocks.
** Filter growth on rock quickly recovered.

State Stream Sanitation Committee is being carried out to determine odor-nuisance effect of long storage of mill waste.

The results of these tests will be reported when completed.

ACKNOWLEDGMENT

The authors wish to acknowledge with sincere appreciation the co-operation and assistance of the organizations and individuals who have contributed to make these studies possible: Cone Mills Corp, the City of Greensboro, North Carolina State Stream Sanitation Commission, and co-workers of Cone Mills Laboratory, particularly Mrs Audree D Anthony and William Presnell.

TABLE X

PILOT-PLANT DESIGN
HIGH-RATE TRICKLING FILTER, ACTIVATED-SLUDGE TANK

Flow, gallons/day	125	
Recirculation ratio	2 to 1	
Number of filters	1	
Size of filters, diameter	1.25	ft
Depth of filters	4	ft
Surface area of 1 filter	1.22	sq ft
Volume of filter stone	4.88	cu ft, or 0.181 cu yd*
Total BOD load on pilot plant (filter)	0.493	lb/day
BOD load on total filter volume	2.73	lb/cu yd
Final settling-tank		
capacity (flow 5.2 gals/hr, recirculation 10.4 gals/hr)	31.2	gal
depth	1.5	ft
diameter	1.8	ft
holding time	2	hr
Activated-sludge tank		
aeration time	6	hr
30-min settleability test	36	%
suspended solids	6980	ppm
sludge index	59.5	

Filter stone, granite chips	
Screen size, inches	*% passing screen*
4	100
3½	60-90
3	30-60
2½	10-20
2	0-10
1½	0- 5

* Note: To convert pilot-plant data above to full-scale-plant filter, it is estimated that 5% should be added to calculated plant filter volume.

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AATCC NATIONAL COMMITTEE ON STREAM POLLUTION

PERCIVAL THEEL

Philadelphia Textile Institute
Philadelphia, Pa

THE National Committee on Stream Pollution of the American Association of Textile Chemists and Colorists is an advisory group that is trying to coordinate the work that is being done by individual stream-pollution committees in the various sections. The local committees in the sections are doing most of the work, and we try to outline new problems and stimulate further interest.

So far, in the past year, there have been published, as a result of work of these sections, a number of case histories of solutions to the problem of waste disposal in textile plants. We have also published a resume of BOD and oxygen-consuming values of various chemicals. A glossary of terms concerning waste disposal has appeared in the *Am Dyestuff Reptr*, the success of which is attested by the large number of requests for reprints. There has also been prepared by the Piedmont Section, under the chairmanship of R H Souther, a bibliography of the work that has been done and published over the years, which will appear in print later.

We are now engaged in the preparation of a most useful brochure entitled "Waste Guides for the Textile Industry". These guides will follow the general format of the waste guides that have been published in other industries, for example, in milk processing, about which probably Ed Leonard will tell you a good bit more. There will be a waste guide for woolen-mill wastes, which is fairly well completed, and we hope it will be ready for publication soon in the *Am Dyestuff Reptr*, and also that reprints will be made through the co-operation of the National Technical Task Committee on Industrial Wastes for distribution to the mills. Ralph Smith of the New Jersey Laundry Association has likewise already submitted a copy of a waste guide for the laundry industry. There will be one too on cotton-mill wastes, prepared under the chairmanship again of R H Souther; and one on printing wastes by a group in the Philadelphia Section under the chairmanship of Louis Cook of the Millville Manufacturing Company. Then, finally, a waste guide is being prepared on wastes from mills handling synthetic fibers, under the chairmanship of C Fred Gurnham, Professor at Michigan State College and Chairman of the Committee on Stream Pollution for the Midwest Section.

We also expect to publish an additional number of case histories during the next year.

I think that gives you a little idea of what we are trying to do in the National Committee.

NATIONAL TECHNICAL TASK COMMITTEE ON INDUSTRIAL WASTES

EDMUND A LEONARD

Alexander Smith, Inc
Yonkers, N Y

IN 1950, Congress passed a Federal law, which organizes the pattern for activity in industrial wastes and their treatment so as to abate stream pollution throughout the country. That public law established the policy that the states would have the primary rights to act in the areas of stream-pollution abatement, and, within the framework of that policy, there was organized a voluntary committee known as a National Technical Task Committee on Industrial Wastes. That Committee is headed by a representative of the Public Health Service and consists of one member of each of the industries in this country which uses water and has occasion to put water and waste into our surface streams. For instance, there is a representative from the meat-packing industry, the fishery industry, canning industry, dairy industry, cheese industry, petroleum industry, paint-and-varnish industry, and steel-and-metal industry, and I happen to represent the textile industry.

It is impossible for one person to represent a whole industry by himself, and since the AATCC is the organization which handles the technical problems of the textile-wet-processing industry, it is the logical mechanism through which all this information can filter. The National Technical Task Committee works through the Public Health Service with other industries so as to collect technical information on what is known about stream pollution abatement and the treatment of specific wastes. Your organization is related to the National Technical Task Committee through the Chairman of the National AATCC Stream Pollution Committee, and through him again works with the sectional committees and through them to the local sanitation authorities and the textile mills. The net result is that the information which is collected nationally and through all industries that are participating is made available to the mills, and Professor Theel, Chairman of the National AATCC Committee, told you some of the projects under way.

I have an oil pollution manual, suggestions to personnels of ships handling bulk oil and water ballasts relating to pollution of harbors by oil.

Here is one on milk, a 20-page summary of means of processing in milk plants so as to minimize the contamination of effluents, a bulletin of the General Motors Corporation giving instructions for handling wastes, a manual on the disposal of refinery wastes, and here is an almost completed draft of the guide for the wool-processing industry.

All these are aimed at summarizing for the plant operator the best techniques for handling his mill processes so as to minimize waste. This has turned out to be one of the most fruitful areas for stream pollution abatement without costing hardly any money, and in many cases saving money. It's been found possible just by the control of processes to minimize the amount of chemicals used. Many times, the plant-effluent problem has been cut by 50, 75 and even 90%.

The NTCC has accumulated a total of 4,000 references on McBee punch cards, which describe methods of treatment that other industries have used and which are available to our industry through the AATCC National Committee.

These are highlights. Naturally the problem of wastes is specific, because the many kinds of wastes have to be handled in many different ways suited to the nature of the stream into which they are being put, and there is a great deal of details to be considered.

This work will continue. By the end of this year I hope all our own waste guides will be available. Anyone who has a problem may confer directly with his local AATCC Committee for Stream-Pollution Abatement. Information is being collected rapidly which will enable the prosecution of research and the quick solution of a problem as it arises.

CLASSIFICATION OF STREAMS IN GEORGIA

WILLIAM H WEIR
State of Georgia Department of Public Health
Atlanta, Ga

ONE of the objectives of your Chairman was to have us give you some of the philosophy, viewpoints and methods of approach of the various states to the matter of stream pollution.

While we speak for a few of the Southern States only, the pattern is more or less the same through the nation. There are differences, however, because the problem cannot be reduced to the precision of an exact science such as the chemical formulae and reactions with which you are so familiar. This is due in part to the fact that we are in a field which not only involves the preciseness and accuracy of chemistry but which also encompasses all the complexities of human relationships, as the last paper well illustrates. In your case you must deal with the public in an endeavor to satisfy many people and at the same time work for a company engaged in a legitimate business to make money. This means accomplishing your objective with the least capital investment, personnel and other expenses. But, regardless of the methods employed in the various states, the common objective in handling this matter of stream pollution is to serve the most people to the best interests of all and with the least harm to any single individual or group.

In this field of stream conservation a few fundamental things—so fundamental that they may be forgotten in our pursuits of technical details—must not be overlooked. A stream of water is something which does not belong to any one individual or corporation; it belongs to all. There may be many, many uses for the stream and many equities involved. One person wants it for one thing, another for something else; one wants it as a source of water supply, another as a means of waste disposal. And here let me state that the use of a stream for waste disposal in any form is not a right but a privilege. Sometimes, through long usage of a stream for this purpose, industry treats the matter as though it were a right but very seldom does one acquire a right to do something which is basically wrong.

To me it is a fundamental thing that, like many other things in a democracy, the acquisition, exercise and use of this privilege carries vast responsibilities requiring individual vigilance at every point, intelligent application of the science involved and sound public relations.

Now, I think another objective of your Chairman was to have the panelists discuss something of the efforts to classify streams or sections of streams according to use, so that you or any others wishing to use the stream may have something in the way of a specification which you must meet. You ask the question, "What must I do with my waste to meet a given condition?" You want an exact quantitative and qualitative specification, which you can use in much the same manner as you might apply in the purchase of a supply of dye. This sounds fine, but in our highly technical and complex world I do not believe one mind or one set of minds can solve the problem, so I think this approach must yet be considered experimental in the field of government and its human relationships.

From an administrative standpoint it would be wonderful if one could look in a book, so to speak, run out to the edge of a column, make a few calculations and get the answer—it would be fine if it worked! In Georgia, however, our method operates on a different basis, and it has been right successful, although it too must be considered an experiment for there is a long time ahead.

I have referred to certain fundamental principles involved and the responsibility of each citizen, private or corporate. Now, let's extend the thought further: If you do something wrong in the world, if you run a red light in traffic and get caught, you go up before a judge. This is good democracy; our government is set up on that principle. If you have a good case and a good lawyer you may be all right. If you don't, you plead nolo contendere.

We operate on the principle that all people have renounced sin and pollution; at least, no one will admit he wants to be a polluter. Those who do pollute our streams usually do so for the lack of knowledge or lack of money. In this approach, which is working very successfully, each individual problem, either existent, potential or imminent, is related to the environment of that area. What will the situation bear or stand?

Not only must we take in the technical factors but human relations as well for, should the case go before a judge, he isn't going to worry about BOD, pH, etc. He wants to know "was somebody damaged; did the fish get killed; were someone's rights violated?" He is interested in the effects from a human-relations standpoint, not the technical details.

And we have left it that way, using the broad machinery of government in which all differences are settled day by day, hour by hour as we go along. It may be a just agreement arrived at by administrative, technical or scientific procedures, or, if someone offends, and there may be offenders in any group, then he must suffer the consequences in a democratic society by having to appear before the court.

I have said this many times; I said it last to the Manufacturing Chemists Association in Houston this spring. One of the most pitiful sights I have ever seen was that of a great industry with much ability, much money, much technical knowledge, going before a nontechnical judge and pleading nolo contendere because they had offended in this matter of stream pollution and because they knew they had not done the things indicated or which could have been done. I regret to see this happen, but I have seen it time and again.

Although the thought may be confusing to you and foreign to your technical principles, the Georgia program for stream control, while having the public interest at heart, realizes the streams must be work horses. They can do much work for us; but, by the same token they, like work horses, must be protected, else they won't work very long.

We depend upon the conscience and the general desire on the part of the public, the people, to do the right thing. We guide them in many ways, and that we don't have an A, B, C program of standards or stream classification doesn't mean we aren't in there pitching!

We welcome industries coming into the State. They don't have to divulge their technical secrets. We don't try to keep up with every process in the chemical, biological or nuclear fields today. We expect them to come up and consult with us as to the general requirements in the area considered, and we will endeavor to help them in any way we can.

But we do not give a permit to sin; a permit to do something which may be all right today but which may be incorrect under another set of conditions next week or next year. The responsibility for any acts of commission or omission must be carried by industry itself.

In closing let me compare stream control in the various states with highway regulations. Some states set definite speed limits, telling you what speed you may travel on any particular stretch of highway. Other states say, "Be careful, look at the road and use common sense".

Georgia uses this latter approach to its stream-control problems and, as I have said, to date the results have been quite satisfying.

CLASSIFICATION OF STREAMS IN SOUTH CAROLINA

GEORGE A RHAME
Water-Pollution Control Authority
South Carolina State Board of Health
Columbia, S C

THE purpose of water-pollution control is to regulate the qualities of natural streams or lakes of water as they may be affected by the activities of man. Water is used for such purposes as drinking, industrial-process supplies, irrigation, recreation, and carrying off waste matters from homes and industries. The latter use is in conflict in varying degrees with all of the others, but is equally essential. The whole philosophy of water-pollution control is based on the fact that, with present-day technics, the activities of man make pollution inevitable. We can only try to regulate pollution for the best advantage to the public welfare.

Waters in South Carolina are systematically classified according to what seems to be the most beneficial use of each stream. When necessary, various portions of long streams may be classified differently. In order to do this, a public hearing is held in the areas containing the waters in question. At these hearings the classification system is explained and interested parties state their opinions about present and future uses and qualities of waters in their locality. All testimony is recorded for the use of members of the Authority in deciding on proper stream classification.

Naturally enough, the controlling factor in determining "most beneficial use" is that use which requires the highest water quality. Our State uses a graded set of classifications with uses defined as follows:

Fresh Water

Class AA Waters meeting State Board of Health regulations as suitable for use for domestic and food-processing purposes with sterilization as the only treatment required. Suitable also for uses requiring waters of lesser purity.

Class A Waters meeting State Board of Health regulations as suitable for use as swimming water. Suitable also for other uses requiring waters of lesser purity.

Class B Suitable for domestic supply after complete treatment in accordance with regulations of the State Board of Health. Suitable also for uses requiring water of lesser purity.

Class C Water suitable for propagation of fish, industrial and agricultural uses, and other uses requiring water of lesser purity.

Class Ca Waters suitable for fish survival, industrial and agricultural uses, and other uses requiring water of lesser quality (to be applied only for benefit of municipal or industrial waste discharges existing prior to May 4, 1950, and only to streams of less than 15 mgd minimum flow).

Class D Temporary classification to be assigned waters receiving wastes for which no practicable means of treatment is known. Dischargers of wastes shall make every reasonable effort to avoid creation of nuisance conditions.

As soon as feasible treatment processes are available, Class D waters shall be reclassified to an appropriate class and further waste discharges governed accordingly.

There are similarly constructed salt-water classes, which need not be discussed today.

Since we are here to discuss waste-disposal problems, your interest in all of this boils down to the simple question, "What kind and how much waste can we put in a stream?" The answer is equally simple, "Anything in any quantity so long as the water in the stream meets the standards of its class". This allows any waste discharger to take maximum advantage of the size and topography of his receiving stream.

The standards of quality for the various classes of streams are pretty well defined by the uses to which the waters are put. A brief outline of some of the requirements make this obvious:

Bacteriological Content

Class AA Such waters require nearly zero coliform and organic content, so no sewage or waste discharge permitted regardless of degree or type of treatment.

Class A The State Board of Health requires a coliform count not in excess of mpn 1000 per 100 ml.

Class B State Board of Health requires a coliform content not in excess of mpn 5000 per 100 ml. Regulation of the U S Public Health Service regarding allowable load for filter plants with preliminary treatment will be followed where they apply.

Other classes, no stated restriction.

Dissolved Oxygen, Minimums

Class AA, 5.0 ppm.
Class A, 4.5 ppm; swamp water, 2.5 ppm.
Class B, 4.0 ppm; swamp water, 2.5 ppm.
Class C, 4.0 ppm; swamp water, 2.0 ppm.
Class Ca, 2.0 ppm.

Limitations generally based on available requirements for fish survival and propagation, plus effect of such limitation on the allowable organic content of water.

pH Variation

Classes A and B range from pH 6.0 to pH 8.0, except that swamp waters may drop to pH 5.0, in accordance with health considerations and the effect of raw-water pH on the operation of water-treatment plants.

Classes C and Ca range from pH 6.0 to pH 8.5, except that swamp waters may drop to pH 5.0, in accordance with available information regarding effects of pH variation on aquatic life, farm irrigation, and operation of plants for the treatment of industrial process water.

Odor-Producing Substances

Class AA, none allowed.

Class A, threshold odor number not over 8.0; phenolic compounds not in excess of 5 ppB.

Class B, phenolic compounds not in excess of 5 ppB.

Other classes, no specific regulation.

Toxic Wastes, Deleterious Substances, Colored or Other Wastes, or Heated Liquids

All classes, quantities or qualities shall not be sufficient to affect adversely the intended uses of waters receiving them. Specific limitations would have to be set for each individual case as required by circumstance, such as regulation of substances producing tastes and odors in fish.

The general rules and regulations of the Authority governing application of these standards are a very important part of the system. They may be summarized as follows:

1) Analytical determinations shall be made according to "Standard Methods" as far as is practicable.

2) Tests for compliance with standards of Class B or above shall be made at the first point of intake or use below any waste discharge. Some deviation may be permitted at intermediate points.

3) Natural causes may, in some instances, make water qualities fail to meet these standards. Standards apply only to variations caused by waste discharges.

4) Sampling points below outfalls shall be selected to allow reasonable mixture of wastes with the receiving stream.

5) Underground disposal by pumping or flowing by gravity into the ground is not permitted. Probably would not be applied to disposal of uncontaminated cooling water. Does not apply to the common septic tank and tile field.

The foregoing brief outline of the South Carolina stream-classification system shows that the Water-Pollution Control Law recognizes waste disposal as a legitimate water use. Intent of the law is to regulate conflicts among various water uses to the best interests of the public. Standards are set up so that engineers may know definitely the requirements to be met by any water use and have a firmly established basis for their design work.

CLASSIFICATION OF STREAMS IN NORTH CAROLINA

E C HUBBARD

North Carolina Stream-Sanitation Commitee, North Carolina State Board of Health
Raleigh, N C

THIS morning I have been asked to discuss very briefly the streams-classification system that is in use in North Carolina, especially with respect to the specific standards that apply to that classification system.

I shall in the interest of time proceed immediately with the discussion of the specific standards and not endeavor to discuss the philosophy behind the classification standards system, or the manner in which the system was developed. To do this, I have a copy of the classification and standard system with me, which I shall be glad to supply anyone who will address me at my office in Raleigh, in any number that you would like to have. My particular presentation is going to be somewhat different from Mr Rhame's, but I think you will find the standards quite similar.

Our first fresh-water class is designated as A-1. It is intended to protect the streams that are used as sources of public water supply, where the only treatment given the water before use is disinfection by chlorine. Quite obviously, this requires a high quality of water; therefore, the specifications are rigid. For instance, under the item of "floating solids, settleable solids, taste and odor-producing substances", the specification says there shall be none attributable to sewage or industrial waste. Under the item of sewage and industrial waste discharges, there shall be none. And under the item of "toxic waste, oils, deleterious substance, colored or other liquids", none attributable to sewage or industrial-waste discharges.

The second class is Class A-2, which is also a designation intended to protect the stream for use as a source of public water supply, but in this case, after treatment through conventional treatment processes. We have in this class considered eight items, and inasmuch as some of these items and some of the specifications for the items will appear in three of the remaining four classes, I shall mention and bring that fact to your attention as I proceed from item to item.

The first item is floating solids, settleable solids, and sludge deposits. The specification specifies that only such amount of these materials attributable to sewage, industrial waste or other waste shall be present as will not, after reasonable opportunity for dilution and mixture, make the waters unsafe or unsuitable as a source of public water supply. That same item appears in the classes B, C and D and the same specification is applicable.

The second item is sewage, industrial wastes and other waste discharges. In this case, none are allowed which are not effectively treated to the satisfaction of the Committee and in accordance with the State Board of Health. This item and this specification is also applicable to Classes B and C.

The third specification, which applies only to Class A-2 waters, is odor-producing substances contained in sewage, industrial waste or other waste, and the specification states only such amounts, whether alone or in combination with other substances or waste as will not, after reasonable opportunity for dilution of the same with receiving waters, cause taste and odor difficulties in water supplies which cannot be corrected by treatment as specified under the conditions related to best usage.

The fourth specification, or the fourth item, considers phenolic compounds. Under the specification for this item, the phenolic compound must not exceed three parts per billion.

The fifth item has to do with the pH of the water, and the specification reads as follows: "Shall be normal for waters in the area which generally shall range between 6 and 8.5, except that swamp waters may have a low of 4.3". The specification in that case recognizes the fact that, under normal conditions, the pH range may fall outside of the limit specified.

Item No. 6, total hardness, and this applies only to Class A-2, shall not be greater than 100 parts per million as calcium carbonate.

Item No. 7, dissolved oxygen, which also applies to Classes B and C, specifies not less than 5 parts per million in trout-producing waters, not less than 4 parts per million for nontrout waters, except that swamp waters may have a minimum of 3 parts per million; and we find in some cases in swamp waters under natural conditions, that the dissolved oxygen will drop as low as 3 parts per million.

Item No. 8 concerns toxic waste, oils, deleterious substances, colored or other wastes or heated liquids. The specification reads, "Only such amounts, whether alone or in combination with other substances or wastes, and at only such temperatures as will not render the water unsafe or unsuitable as a source of water supply for drinking-water purposes or injurious to fish, wild life, or which will adversely affect the palatability of same, or impair the waters for any other best usage established for this class."

These are the items and specifications that apply to Class A-2 waters: Class B waters or waters that are intended and that are used as bathing areas and the standards for those are quite similar in most instances to those for Class A-2.

Class C is the designation that applies to waters which are intended to promote fish life. The items and specifications for Class C are quite similar to Class A-2; however, the matter of waste disposal, the item relating to waste disposal, is not included, and the items relating to hardness and phenolic compounds are also omitted in this Class C.

Class D is a classification that is intended to protect the waters for agricultural purposes, including stock watering and irrigation. Also, it protects the water for industrial cooling purposes.

The specifications for floating solids are identical to those for Class A-2, except that they shall not be in amounts sufficient to interfere with the use of the water for agricultural and cooling purposes. The pH is identical, the dissolved oxygen drops in this case to 3 parts per million, and the specifications covering toxic wastes are identical to those specified under A-2 waters.

The last class is designated as Class E, for which I would like to read the language describing the best usage of the water. This reads, "Navigation, and the disposal of sewage and industrial wastes or other wastes, and any other uses except agriculture, source of industrial cooling waters, fishing, bathing or source of water supply for drinking, culinary or food processing purposes".

The conditions related to best usage are as follows: "Waters will be suitable for navigation where navigable waters are involved and may be used for waste and sewage disposal to the extent that the stream will accommodate same within the limits of the prescribed specifications for this class. This class will not be assigned to waters which can, in the light of considerations prescribed by the Statutes, be properly assigned to a higher class".

We recognize in this particular class that in some instances our waters must be used quite extensively for industrial wastes, and domestic sewage disposal, therefore, this class is intended to cover such waters.

This covers briefly the fresh-water classification and I will close without attempting to discuss the four tidal-salt-water classifications.

POLLUTION CONTROL BY RECOVERY OF CAUSTIC SODA

W R STEELE
Solvay Process Division
Allied Chemical and Dye Corporation
Syracuse, N Y

I ENJOYED Mr Weir's approach to this problem when he suggested that we are not only scientists and chemists, but citizens of a great country. I should like to carry that just a little farther and say that we are stewards of God. He has given us this earth to use; not to destroy, nor to dissipate, but rather to conserve and improve and ultimately to pass on to our children, and they to their's, so that we can all live happy, peaceful, God-motivated lives.

But this forces us into a dilemma. On the one hand we have to have industry and the products of industry in order that we may enjoy its benefits and do the things that we think we have to do, and on the other hand we have to have profit, so that if we load too many costs on industry, then industry falters. There are thus two horns to this dilemma.

It so happens that, in a bleachery performing the operations of desizing, mercerizing, and bleaching, usually 80% of the caustic that goes into that operation is not consumed at all, but rather wasted. That contributes to high pH, and it makes it impossible to treat the waste successfully. Now, there are many mills in this country that have solved that problem. There is one mill in Virginia which has installed a recovery system and recovered 3,500 tons of caustic soda the first year.

The cost of recovery was $200,000, and they got the $200,000 back the first year. Furthermore, they improved the quality of their cloth by improved washing on the tenter frame, where the caustic is recovered, and they were able in part to eliminate shrinkage in the filling threads and therefore to obtain more cloth. So, it is possible to get back this caustic, and we have been making surveys in bleacheries all over this country with respect to this problem.

A survey briefly includes determining the amount of caustic coming into the plant, those operations where the caustic is used, what happens to it, how much is consumed, how much is used, how much is wasted, and how you can pick up the waste. The key to that problem is washing out the caustic on the tenter frame, to increase the caustic content of the wash liquor, to reduce its volume, and simultaneously to reduce the content of caustic soda in the cloth leaving the tenter frame. A lower content of caustic soda in the cotton minimizes shrinkage, and this stronger liquor can be used for various and sundry operations that don't involve the expenditure of too much capital.

And then if there is any dilute caustic soda left over that cannot be used up in dilute form, it can be concentrated in evaporators for re-use in mercerization. In the new evaporator, 90% of the steam used is recoverable, so the steam load isn't great. If the plow-back of strong caustic soda is too great for use in mercerization and plissé finishing, then it may become necessary to do something to remove the impurities and to produce the highest-purity caustic, which can be used in a multiplicity of places.

This isn't theoretical, it isn't an idle dream, it has been done and is being done. I want to salute all of the 40 or 50 bleacheries who are working on this program all over the country.

They are in fact, I believe, true stewards of God. They are going to have their cake and eat it, too.

AATCC Monograph No. 2

"THE APPLICATION OF VAT DYES"

"The group of fifteen editors responsible for this monograph consists of a well-balanced cross-section of American industry concerned with the production, marketing and application of vat dyes. The AATCC is to be congratulated on the production of a comprehensive survey of American vat dyeing and printing practice which is the major theme of this application . . . the book will be useful as a work of reference at this side of the Atlantic and as a working manual for the American colorists for whom it was designed. . . . If a clear account of American practice is required . . . the enquirer must have access to this volume."—*JOURNAL OF THE TEXTILE INSTITUTE* (England).

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". . . this monograph should be in the hands of every user of vat dyestuffs, every student and every teacher. The book is well indexed and includes valuable lists of equivalent trade names. It will certainly take its place as a standard book of reference."—*JOURNAL OF THE SOCIETY OF DYERS AND COLOURISTS* (England).

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Hudson-Mohawk Section——

Symposium on "Flameproofing Textiles"

THE following two papers were presented as parts of a symposium on "Flameproofing Textiles" at Jack's Restaurant in Albany, N Y, on Sept 24, 1954. A third paper, "Flammability and the Law", by Herman E Hager appeared on pages P778-9 of our November 22, 1954 issue.

FLAMMABILITY TESTING—— ITS RELATION TO THE LAW

CAMERON A BAKER

United States Testing Co

Hoboken, New Jersey

The development of the present AATCC test method and test equipment for testing the flammability of textiles took place under pressure from legislative bodies that had been aroused by a number of deaths over the country from dangerously flammable materials. When the method and equipment finally became available for test purposes, they were frozen as a Commercial Standard and were referred to in Federal law. Although, unfortunately, AATCC freedom of action in improving the equipment and method was impaired by this situation, the Flammability Committee has continued and should continue further, the improvement of the method and equipment.

The author discusses the development and use of the flammability testing method and points out that a fabric is really unsafe when the backing burns through in the test as presently conducted.

INTRODUCTION

HERMAN HAGER has outlined for you here the origin and development of the Flammable Fabrics Act, with which we are all now familiar.[1] I do not believe, however, that he placed proper emphasis on the role AATCC research has played in this development. Perhaps this was due to modesty on the part of Dr Hager, since a great deal of the credit must go to him for his leadership in holding a committee together over a period of ten years. This was an extremely active committee, there being only a few lulls created in its work through setting aside action in national legislative circles.

The basis of the Flammable Fabrics Act is Commercial Standard 191-53, which in turn is based on the AATCC testing method, as acknowledged in the Standard. This development of apparatus and test methods took place under the adverse condition of pressure from legislative parties to draft a test method. Unlike other test methods, which AATCC is free to alter with improvements in technical knowledge, the flammability test method became frozen when drafted as a commercial standard and referred to in the law. It will take an act of Congress to make a change in the testing technique now described by reference to the Commercial Standard. This does not impede or change the utilization of improved methods by AATCC, but to depart from the Commercial Standard would render the method useless in connection with the Flammable Fabrics Act. Therefore, the work of Hager's Committee is not through. The Committee is charged with the continual investigation and improvement of methods and proof of these methods, which are then taken in hand by the Department of Commerce and, through suitable channels, written into the law by an amendment to the Act.

You can best realize the importance of the work of this Committee when you consider that, upon the results of tests on this apparatus, a supplier of textile merchandise can be adjudged to have committed a Federal offense by placing faulty merchandise in interstate commerce.

DEVELOPMENT OF TEST METHOD

The development of the test method was a step-by-step procedure utilizing all the available information on the flammability characteristics of textile materials. This information was scant. Historically, the records kept on incidents of burning attributed to textiles by insurance companies and hospitals were of little help. No description of the textiles involved existed, and all fires stemming from textiles, whether they were the fault of the material or not, were lumped together. Secondly, cases with which we were primarily concerned were very often not fatal and were therefore not made part of the record of fatalities. Our best source of information was the interest and diligence of interested persons who were able to produce textile materials of apparel use which had been involved in fire accidents. Many of these garments were the principal exhibits in court cases. Even so, as Hager has pointed out, virtually all textile materials will burn and therefore, of the samples collected from fire accidents, a careful sorting based on the physical and chemical nature of the material involved had to take place.

TEST EQUIPMENT—— The test equipment illustrated here is the latest in AATCC development and is the one referred to in CS 191-53. It is known as the AATCC Fammability Tester and is designed for use in testing all textile materials except fabrics coated or otherwise

[1] Dr Hager's paper "Flammability and the Law" appeared on pages P778-9 of the November 22, 1954 issue of Am Dyestuff Reptr.

treated with cellulose nitrate products. The exclusion of cellulose nitrate coatings, I might explain, is the result of an effort on the part of the Federal Trade Commission (FTC) to enforce a more rigid control of the use of this material in apparel fabrics. The SPI Flammability Tester, which was designed expressly for films, is used in the measurement of this material. The test is more rigid because the material is first ignited and then measured for rate of burning as opposed to a combination of these two features in the AATCC Flammability Tester.

The instrument, as it stands today, provides a draft-proof chamber in which to conduct the test. Ventilation is provided by a series of holes in the top rear section of the cabinet and a vented strip at the bottom of the front door. The door is glass so that test observations can be made. Various types of ignition mediums were considered. Common sources of clothing fires are accidental contact with matches, carrying of lighted candles, flying sparks from open fires, contact with gas flames in space heaters and stoves, and contact with electrical heating appliances. The prevailing system of space heating by electric or gas heaters in the State of California, for instance, provides the chief source of accidental ignition in that state, whereas the common source of ignition in the East is working or playing around open fires.

THE TEST———Realizing that there is a limit to the resistance to ignition which is to be expected of a normal textile product, we selected such a product in the form of an 80-square sheeting and used it as a criterion of normal resistance in the adjustment of a flame which would just scorch but not ignite. With the plan in mind to make the test unit as portable as possible and to avoid the pitfall of variation in btu value and pressure of city gas, cp butane was used as a fuel. A suitable flame length adjusted by means of a manometer was found to be 5/8 of an inch. The gas jet is automatically driven and approaches the fabric to within 1/2 of the flame length. This yields a temperature of approximately 1400°F on the face of the sample. The flame is applied for exactly one second by means of a spring motor drive, and timing is automatic, starting with the first impingement of the flame and ending when a stop cord 5" away is cut by the flames. The sample rack is comprised of a movable member, which supports the sample holder at a 45° angle. One of the experimental units with which the Committee worked provided a variable-angle rack, on which studies were made from the horizontal through to the vertical. The intricacies of measuring vertical flame travel made a sharp angle seem impractical, and the horizontal placement of the specimen appeared to change the burning characteristics, so that the 45° angle was derived. The rack on which the sample is placed in suitable holders is movable back and forth to compensate for variations in the thickness of the sample. Essentially, in this unit, the operator mounts a predried specimen in holders on the rack, laces the stop cord and sets the apparatus in motion for an automatic recording of time necessary to ignite the sample and burn a 5" length.

The procedure of testing is complicated by factors of sample preparation and the method in which some samples burn. I refer particularly to low-napped or pile-surfaced textiles, which show two types of burning known as primary (facing) and secondary (backing) burning. The test procedure provides, in effect, means for separating the primary burning, which is considered harmless in itself, from a combination of primary and secondary burning, which is considered hazardous. A surface flash that yields insufficient flame intensity to ignite the backing, the burning of which would inflict damage to the wearer, is considered a safe fabric. The wearer may be alarmed and his hair may be scorched, but if the backing material fails to ignite, that would be the total extent of the damage. In instances of serious burning, the fabric in question usually yields sufficient heat either to burn the wearer directly or to ignite heavy material in contact with him to inflict damage. We have discovered through continual use of the test procedure that there is little or no question as to the results obtained on fabrics commonly regarded as hazardous materials, such as torch sweaters, cowboy suits, French chenille robes, etc. The problem in testing arrives from those fabrics that are borderline, notably, cotton flannels and brushed knits. We are aware of the fact that the amount of pile on the surface of the fabric will vary with the amount of brushing or napping the fabric has received. The variations in pile height or loose fiber on the surface of the material will regulate the intensity of flame encountered in burning. When sufficient pile has been raised, the intensity of burning will cause scorching or ignition of the backing material. At present we rely upon the test operator to examine the fabric from the reverse side for scorch marks or burned holes to judge whether ignition occurred. Any sign of burning from the reverse side would serve to classify the material as hazardous if the recorded time of burning, in conjunction with these visible signs of backing damage, is less than four seconds. The work which Hager mentioned as now in progress to eliminate this dependence upon the test operator is an example of the continuing work of the Research Committee.

FURTHER RESEARCH

We are now investigating the possibility of either providing a flame barrier which would stop a minor surface flash or a fusable stop cord which would measure the flame intensity in addition to the time of burning. We visualize the use of a fusable material, such as a monofilament nylon or other thermoplastic material requiring an amount of heat to rupture which would be capable of igniting backing materials. Such a material would furnish an automatic measure of flame intensity.

We are also investigating the possibility of using disposable holders for the test specimen to eliminate the use of metal sample holders. The objectives here are a saving in time necessary for the cooling of these metal plates and the weight involved in handling a number of sets of sample holders.

In the meantime, the test apparatus, in its present form, is being used for the purpose of enforcement of the Flammable Fabrics Act. The Federal Trade Commission has promulgated a set of rules and regulations for enforcement of the Act. The rules set forth the conditions of test and the method and frequency of drawing samples. Test results are used as the basis for guarantees, which are being transmitted through invoices or other papers accompanying each shipment of goods in interstate commerce. In order to relieve the industry of the burden of continuous tests on products of known satisfactory performance, certain provisions have been made in the rules for basing guarantees on published data. The Commission will accept, for example, published results on 80-square sheeting obtained from any one or more sources as a basis for guarantee by any other supplier. Under these provisions, a number of trade associations have banded together to compile lists of textiles satisfactorily meeting the requirements of the Flammable Fabrics Act. The published results are known as "initial tests" and should represent at least two individual tests on two separate lots of fabric of the same quality. Again, by way of example, an 80-square sheeting given a rating in an initial test for the purpose of publication should have been tested at least twice, the results having been obtained on either separate lots from two manufacturers or two different lots issuing from one source.

The provisions of the Federal Trade Commission (FTC) are too detailed even to attempt to summarize at this time, but, in general, the number of tests required for various types of fabric increases as the critical nature of the materials involved increases. Few tests are required on samples which burn at a slow rate. Fab-

rics of over two ounces in weight and having a plain surface require only an initial test. Napped goods, on the other hand, require frequent tests at intervals of not more than one month while in production, or, if the production exceeds 50,000 yards per month, the fabric shall be tested every 50,000 yards or fraction thereof. In between these two extremes fall the whole range of wearing-apparel textiles and the frequency of tests outlined by the FTC.

You will notice in the test procedure an outline of methods for the preparation of the specimen for the test. Certain of the provisions describe washing and drycleaning techniques. This sort of preparation is designed to detect flame-resistant finishes of nondurable nature. Since the use of finishes that lack permanence would serve to build a false sense of security in the wearer, such treatments must meet the test requirements after standardized washing and drycleaning. Furthermore, there are cases where sizing materials (natural gum in the case of silk) and the physical condition of the test specimen will create a satisfactory rating in an original test, whereas the goods after laundering and drycleaning fail to pass the test. The cleaning procedure, therefore, is intended to evaluate the resistance of the material to flaming: the resistance imparted either by flameproofing treatments in themselves or by normal finishing operations which contribute toward lowering the rate of burning.

Hager's Committee is also working at present on an investigation of simplified methods of preparing the specimen for testing.

CONCLUSION

I would like to summarize this by saying that, after many years of intense committee action, the Flammability Committee of the AATCC has developed a satisfactory instrument for the purpose of measuring the flammability rate of consumer textiles. It is recognized that there are certain features in the present test procedure which require further study and which are being studied in the continuing activities of your Research Committee. Any forthcoming improvements in the test procedure will probably be installed through revision of the Commercial Standard and made part of the Flammable Fabrics Act through Congressional action. We should take this opportunity during the trial period of the enforcement of the Flammable Fabrics Act to make any improvements in the apparatus or procedure. The critical nature of the use to which flame-test results are being put warrants continued AATCC consideration of the problem of flame testing.

FLAMEPROOFING COMPOUNDS FOR NYLON

MAURICE FISHMAN

Lee Dyeing Co
Johnstown, N Y

Although pure nylon is quite flame-resistant, nylon in the presence of other fibers or finishing agents that can form a framework for the nylon may become quite flammable. It is pointed out that thiourea-formaldehyde cocondensed with urea-formaldehyde produces a wash-fast inflammable finish on nylon-containing fabrics.

INTRODUCTION

IT IS well known that synthetic fibers are much more resistant to burning than are the so-called common fibers, such as cotton, rayon, silk, or wool, but what is not so commonly known is that these fibers under certain conditions can and do burn with a ferocity fully as violent as the natural fibers.

Let us take nylon for example, as we have had more opportunity to acquaint ourselves with this synthetic than with the newer ones. Clean, finish-free, undyed nylon will not flash-burn. When a flame is applied to nylon, it will melt at approximately 480-500°F. As the flame is removed, the melt will drip away from the rest of the fabric, causing a hole where the flame was applied but also preventing the spread of any additional flame areas. This clear nylon can be considered as flameproof, as this term implies a resistance to any spread of flame after the ignition has occurred.

FLAMMABLE NYLON —— However, these desirable properties in nylon can be destroyed by the addition of certain dyes, sizing materials, finishes, and even the addition of flame retardents so effective on cellulosic materials and wool. Also, the inclusion of cotton, rayon, or wool with nylon may put this blend beyond the allowable limits of fire resistance even though flame retardents have been applied to the other materials. What happens apparently is that, when the flame is applied to a treated nylon fabric, the molten nylon is prevented from dripping or falling away by the sizing, which acts as a framework to support the molten nylon. To further illustrate this point, it is quite possible for an asbestos nylon fabric to burn with much intensity when ignited. Here again the asbestos acts as a support for molten nylon, preventing it from dripping and extinguishing itself. This support for clean nylon even extends itself to chrome-dyed nylon, which approaches a critical stage as the amount of chrome dye increases.

FLAMEPROOFING NYLON

The melamine- and urea-formaldehyde-resin treatments for nylon require high concentrations of resin. In many cases 50 to 70% of resin solids is needed to produce a hand that is desired in the trade. These large amounts of resin solids act as a perfect crutch for the nylon, giving flame tests of 2-3 seconds on the AATCC flame tester. Melamine-formaldehyde resin is the greatest offender, followed by the urea-formaldehydes, which vary in behavior from monomethylol urea to the partially polymerized urea-formaldehyde resins. This can possibly be explained by the fact that melamine-formaldehyde resins resist melting at the critical melting temperature of nylon (480-500°F) slightly better than do the U-F-type resins.

Little work has been published concerning methods for flameproofing nylon. Tests with various ammonium and sodium salts as additions to urea-formaldehyde resins have shown that the ammonium-containing salts are much more effective than the sodium salts, ammonium sulfamate, and thioures being the best. There are several possible explanations for this observation. When nylon is heated with a flame, the material melts and white fumes are given off, which apparently consist of ammonium carbonate. On further heating, the melt ignites and burns with a hydrocarbon flame of short duration leaving a black viscous or brittle residue, depending on the type of nylon and the time of heating. Hassel-

strom and co-workers from the office of the Quartermaster General postulated that the sulfur- and halogen-containing chemicals which prevent flame propagation work by producing, on pyrolysis, acidic sulfur compounds and hydrogen halides. These decompose the ammonium carbonate produced early in the burning of nylon with the liberation of carbon dioxide and nonflammable ammonium compounds.

A possible answer to this problem would be a resin, probably of the formaldehyde type, containing sulfur or halogen compounds, which would have a melting point very close to the critical melting point of nylon, thus allowing nylon and resin to drop off at the same rate. It would also have to have the other desirable properties of the M-F and standard U-F types of resins. We believe thiourea-formaldehyde has a melting point closely approaching that of nylon. When a flame is applied to a thiourea-formaldehyde-treated nylon, the flame is no longer propagated. We notice around the edges of the burnt area a combination of ash and a hardened area in contrast to a simple hardened area with pure nylon and complete burning to ash when treated with high concentrations of M-F- or U-F-type resins.

Unlike cellulosic fibers and wool, where the application of fire retardents slows up the burning process until, when enough fire retardent has been applied, no further flame spread follows ignition, synthetic fibers react in a different manner. With lightweight synthetic fibers we have a "go" or "no-go" proposition. If enough suitable fire retardent has been applied, no flame spread follows ignition. If an insufficient amount has been applied, we have a continuous, uninterrupted, flame spread.

PREPARATION OF THIOUREA-FORMALDEHYDE RESINS ——— As outlined by Axtman and Sweet of DuPont, thiourea-formaldehyde resins can be prepared by reacting thiourea and formaldehyde with pyridine added as a catalyst for the initial reaction. The thiourea-formaldehyde obtained in this method has a distinctly objectionable pyridine odor even though only one part to 300 parts is pyridine. We have found that soda ash can be used in place of pyridine to provide the initial catalysis for this reaction.

Another method of preparation for a thiourea-formaldehyde resin employs the method whereby thiourea reacts directly with a methylol-modified urea. This methylol-modified urea, made by reacting cyclic ethylene urea with formaldehyde, has enough free formaldehyde present to react with any free thiourea. Here thiourea reacts like urea. The hydrogens attached to the nitrogen are active and react with the formaldehyde. When these are applied to nylon, they all cocondense to give a cyclic urea-formaldehyde/thiourea-formaldehyde condensation product.

PROPERTIES ——— Thiourea-formaldehyde properly applied to nylon is fast to both washing and drycleaning. Samples given three successive No. 3 AATCC launderings show no increase in flammability.

The possible dermatological effects of thiourea-formaldehyde presented a stumbling block to its widespread use, but recent series of tests have shown that it is suitable for textile applications.

CONCLUSION

While it is not possible from these preliminary data to draw final conclusions, we have established the fact that nylon with additives can be successfully flameproofed with thiourea-formaldehyde-resin compositions.

OBITUARY

WALTER F FANCOURT, III

WALTER F FANCOURT, III, general chairman of AATCC's 1949 Annual Convention, died May 19th in Presbyterian Hospital, Philadelphia. He was 44.

Mr Fancourt, a graduate of Philadelphia Textile Institute, assumed the presidency of W F Fancourt Co in April, 1954 upon the death of his father, W F Fancourt, Jr, founder of the Philadelphia firm.

As a member of the Philadelphia Section, Mr Fancourt was very active in sectional and national affairs of AATCC. He was also very active in the Textile Chemical Manufacturers Association, of which he was president; Phi Psi Fraternity, which he served as grand council president in 1954; University Lodge No. 610, F and A M; Lu Lu Temple, Philadelphia and Sea-view Country Clubs; and the Sea Isle City Yacht Club, of which he was a former commodore.

He is survived by his widow, Lyona; a daughter, Joy; a brother, John L, an executive in the Fancourt firm; and a sister, Edythe Morris.

Membership Applications

April 26, 1955

SENIOR

Alfred W Hunter—Research chemist, American Viscose Corp, Marcus Hook, Pa (Phil). Sponsors: J W Schappel, R J Hakim.

David W Spaulding—Technical service, dyeing and finishing, E I du Pont de Nemours & Co, Inc, Wilmington, Del (Phil). Sponsors: G M Richardson, B F Faris.

ASSOCIATE

Roger L Howard—Sales representative, Morton Salt Co, Chicago, Ill (MW). Sponsors: P J Smith, P B Stephenson.

CORPORATE

Pawtuxet Valley Dyeing Co, Inc (RI).
Morgan Dyeing & Bleaching Co, Inc (MW).

April 29, 1955

SENIOR

John D Farrell—Dyer, M Warshow & Sons, Inc, Milton, Pa (Phil). Sponsors: P Moran, D W Layton.

Oliver J Goldstein—Plant manager, Moretex Chemical Products, Div Moreland Chemical Co, Spartanburg, S C (Pied). Sponsors: B A Gustin, Jr, J Livak.

Floyd A Kerwin—Dyehouse foreman, Perry Knitting Co & Canipe Corp, Perry, N Y (HM). Sponsors: D O Hamer, Jr, E A Chevrette.

John L Luckman—Manager, Weldon Bros, Inc, Santa Monica, Calif (PSW). Sponsors: A H Roberts, R W Sumers.

Murray J Maurer—Manager, Union Piece Dye Works, Inc, W Sand Lake, N Y (HM). Sponsors: H Gendreau, E A Chevrette.

Charles Spinner—President, Accurate Yarn Dyeing Corp, Jersey City, N J (NY). Sponsors: R F Holoch, C H Ludders.

Charles T Sutherland—Vice president, Madison Throwing Co, Inc, Madison, N C (Pied).

JUNIOR

Edward M Cornell, Jr—Converter, Amerotron Corp, New York, N Y (NY). Sponsors: J P Rulli, L R Burgess.

ASSOCIATE

Charles H Lumpkin — Vice president, Printed Fabrics Corp, Carrollton, Ga (SE). Sponsors: R L Stephen, W F Crayton.

CORPORATE

National Institute of Drycleaning.

APPLICATIONS FOR TRANSFER TO SENIOR MEMBERSHIP

Conrad G Fleisher — Alberto Saltiel
Henry H Noon — John I Weierman

183rd Meeting

TECHNICAL COMMITTEE ON RESEARCH

THE 183rd meeting of the Technical Committee on Research was held on Friday afternoon, April 29, 1955 at the Hotel Dennis, Atlantic City, N J, with vice chairman Charles A Sylvester presiding in the absence of chairman Charles W Dorn. Mr Dorn, Harold W Stiegler, director of research, and P J Fynn, were attending the atomic bomb tests in Nevada at the time.

Mr Sylvester invited Raymond W Jacoby, AATCC president, to say a few words, and Mr Jacoby responded with an expression of sorrow over the death of Edwin P Johnstone. In tribute to Mr Johnstone, who had served as technical manager of AATCC's research laboratories in Lowell, the group stood for one minute in silence.

Leonard S Little, chairman of the Executive Committee on Research, also expressed his sorrow over the loss of Mr Johnstone. He requested that candidates for the post left vacant by Mr Johnstone contact him or Mr Dorn. In addition to a replacement for Mr Johnstone, the Committee also hopes to obtain additional help to carry on the work planned at Lowell. In his remarks, Mr Little praised Albert E Johnson for his work as chairman of the Corporate Membership Committee, fund-raising arm of AATCC research.

WORK AT LOWELL——— G Robert Thompson, administrative manager at the Lowell laboratories, reporting in the absence of Dr Stiegler, outlined the work being conducted there as follows:

Washfastness. At the present time Lowell is undertaking a threefold investigation in conjunction with the Washfastness Committee:

1) An attempt is underway to expand the alternate light and wash program so that it may include, in addition to the present 3A procedure, 2A and 4A Test Methods. Thanks to the efforts of Mr Fynn, interested textile people have provided a set of 15 fabrics for the 2A study and 16 fabrics for the 4A study.

2) There appears to be some feeling in the industry that the staining of multifiber fabric which occurs in the 3A Test is not giving a true picture of what happens in practice. For further study 17 fabrics representing various degrees of fastness are available, to which have been added the three 3A Standards and the 4 "old" cotton washfastness standards.

3) The third project will be an attempt to illustrate any differences which may be produced in color change when optical-bleach-containing washing agents are used. Both soaps and synthetic detergents will be employed. Test materials will be chosen from the above-mentioned 55 textile fabrics. Representative samples of detergents have been received.

Flammability. Lowell's participation in any of the active flammability projects has been seriously hampered by the death of Mr Johnstone. It is believed that the tests on the variable-angle apparatus have been sufficiently extensive to indicate definite trends which may necessitate additional study on other phases of flammability testing.

Substitution of a tagboard (lightweight cardboard) specimen holder for the present metal holders is being studied. One of Mr Johnstone's last contributions was the preparation of a supply of such holders for an inter-laboratory study and the fabrication of a simple rack so that many holders could be conveniently placed in desiccators.

Revised Dynamic Absorption Test. An effort will be made to clear up some doubts which exist concerning the reliability of the new test. A series of fabrics has been supplied by the Natick Command so that an inter-laboratory study can be conducted on water-repellent fabrics both before and after laundering.

Accelerotor. With the idea of achieving better reproducibility, research personnel are trying a sponge rubber liner in the Accelerotor. It is evident that, by softening the blow between rotor, fabric and abrasive liner, a more even or uniform result can be obtained.

Trials with Durite paper 400 as a possible replacement for the present multicoated abrasive liners are to be undertaken. This is the paper which Dr Scroggie has used with apparent satisfaction. It will be a one-test-per-liner proposition, but any slight cost differential would most likely be offset by the ease and constancy of procurement.

Wash-wear testing is being further explored. This method of testing should tie in better with end-use experience for denims, sheetings and the like.

Some interest has been shown in the use of the Accelerotor for wear abrasion on lightweight leathers, such as glove stocks.

The Accelerotor is being used in an effort to distinguish differences between alkali-cellulose finishes and starch finishes on household sheetings. Two grades of sheetings, 128 and 140 count, have been tested under three conditions: 1) as finished, 2) after boil-off, and 3) after boil-off and bleach.

CS-59-44. Twenty-five AATCC test methods, which have been proposed for inclusion in government publications, have been mailed to 18 AATCC members for comments and suggestions.

Creaseproofing. A simple questionnaire has been circulated in an attempt to gather information as to the advisability of continuing the method and also to determine the popularity of the two AATCC methods for determining crease recovery.

END USAGE———A new committee on End Usage is headed by Mr Sylvester. The objective of this committee will be to promote better correlation between AATCC Test Methods and consumer end usage. To reach this objective the Committee will investigate wear tests made available by industry, and when applicable, channel these to the proper subcommittees for correlation with existing tests or for use in developing new ones.

On the immediate agenda is the development of a test to evaluate the colorfastness and dimensional stability of work clothes when subjected to the vigorous wet abrasion encountered in cleaning methods used for this type garment.

It is proposed to include both garments and yard goods in this study. It is ten-

tatively planned to subject these to 1, 3, 5, 10 and 20 washings by several laundries using a work-clothes-cleaning procedure. A preliminary investigation will precede the major study to determine the effect of such a procedure on several samples of work clothes. Several samples from OMC will also be included in the study for correlation with results obtained by them in their mobile laundries.

BLEACHING———R P S Black, secretary of this Committee, reported that the entire whiteness determination question had been reviewed and the conclusion reached that the Committee was on the right track. Further standards will be set up and submitted for further testing by the members for approval or rejection.

Tests for determining the fastness of colors to peroxide bleaching were reviewed. Before any revision of the tests is proposed, recently suggested methods, such as "Steam Pipe Technique," will be examined carefully.

The Committee will try to adopt a set of standard concentrations for potassium permanganate, sulfuric acid and other solutions used in analyzing bleach baths. Some manufacturers of hydrogen peroxide supply these solutions to mills at different concentrations, which makes it very confusing to mill personnel.

The Brookfield Viscosimeter, which has been reported as quite accurate in the central range for fluidity determination, will be investigated.

A new sequence, which should lead to more realistic determinations of the noncotton content of bleached cloth, was proposed. This consists of making the following determinations on the same piece of material in the order given; Ulecter extractables, enzyme extractables, oils, fats, waxes and ash. The total of these figures will be the noncotton content.

Because of the magnitude of the work facing the Committee and the fact that many of the members are connected with the chemical suppliers, it was agreed to make an effort to obtain additional mill personnel who are, or should be, vitally interested in this work.

WATER ABSORBENCY ——— Ralph B Smith, chairman, reported that the testing for water absorbency using the wire screen method has been continued using the same fabrics as previously plus three nonwoven paper diapers. In this new series of tests the samples are the exact diameter of the screen (⅞"). This method measures only the water absorbency of the sample exposed on the screen in contrast to the method used in the prior series, where areas beyond the screen edge were progressively wetted as the test continued.

In another series the water absorbency of most of the fabrics tested by the wire-screen method has been tested by most of the common methods previously used. The reliability of the results of these test procedures compared with one point (¼ cc) on the water absorption curve obtained by the wire-screen method.

LIGHT FASTNESS———Chairman R C Allison asked Frank J Rizzo to give a report on the status of Wool Blue Standards. Mr Rizzo reported that necessary steps have been taken to correct the Fast Primary that seemed to be out of line and it is hoped that in a short time the Wool Blue Standards will be ready. The Committee, with the approval of ECR, will set up a procedure for selling these new standards.

Charles H A Schmitt reported on the Committee's program for investigating the proper method of testing for sunlight. He pointed out that the Committee, which has spent many years improving the Fade-Ometer, now will also concentrate on sunlight, which seems to have more variables. The project will be started in June and continued for one year. Although many factors influence fading, Mr Schmitt stated that temperature was probably more of a factor than moisture content.

It is planned to have reports of the work being done by Mr Seibert made available to the Committee and ECR. A committee headed by Matthew J Babey will abstract these reports for publication in the *Dyestuff Reporter*.

STANDARD SOILS COMMITTEE ———Chairman O C Bacon advised that a report of the work done during the past three years under George Wiseman will be presented for publication. This work deals with one soil on 7 fabrics, each made of different fibers.

In addition the chairman, with the assistance of R E Wolfrom, will write up the test procedure developed prior to Mr Wiseman's chairmanship and established more firmly during the past three years. This procedure will be recommended as a tentative method for washing soiled fabrics and for measuring reflectance. Data will be included to demonstrate the reproducability with two soiled fabrics. The Committee will not recommend a standard soiled fabric because it has not been able to agree that there is such a fabric.

The Committee plans to consider the possibility of developing test methods for specific end usage of detergents in the textile industry, eg, in the kier boiling of cotton.

FLAMMABILITY———Chairman H E Hager reported that this Committee has suffered a profound loss through the death of Mr Johnstone, who devoted practically his full time to it. Dr Hager outlined the work done by Mr Johnstone during the past eight years. (Mr Johnstone's more recent work will be outlined at a later date by Dr Stiegler).

Dr Hager reported that, since the flammability test was developed ten years ago, three items for improvement have been suggested.

a) One was electric timing in place of present mechanical arrangement. Various circuits were tried by different groups with some success. However, with the enactment of the flammability law and resultant increase of testing, interest in electric timing increased. Mr Freedman and Mr Chaucer of Macy's Bureau of Standards have developed an electrified instrument in which the circuits are said to function with excellent reliability. An article on this unit was published in the March 28, 1955 issue of the *Dyestuff Reporter*.

b) The second item was the development of a cardboard holder in place of metal holders. This was reported at the National Fire Protection Association's meeting with Fire Marshal Yockers of California as the suggestor. The results using the cardboard holders were encouraging and this improvement could be incorporated in a revised commercial standard.

c) The other suggestion was the Variable Angle Tester devised also by Mr Yockers.

Dr Hager asked Arthur Spiegelman, chairman of National Board of Fire Underwriters' Committee on Wearing Apparel, Subcommittee on Tests and Test Methods, to give a report on his work with the Variable Angle Tester.

Mr Spiegelman reported that many samples were tested at three laboratories—AATCC, National Bureau of Standards, and the California Fire Marshal—to obtain satisfactory tests. He pointed out that the results indicate:

a) The relative flammability ratings of the various fabrics change with relation to each other as the angle of testing is raised towards the vertical position. This apparently could be serious enough to cause one to misjudge the degree of hazard of some materials through the use of a 45° test angle.

b) The testing of the longer 10-inch samples generally gives more reproducible results than the smaller 5-inch samples.

c) The degree of accelerated burning of a fabric is a function of the length of the test specimen and the angle at which it is tested, as well as the composition and weave of the fabric. The degree of acceleration to be expected during the burning of a fabric is not reasonably exhibited in the testing of a 5-inch sample at a 45° test angle.

It was expressed that the primary purpose in conducting flammability tests on wearing apparel textiles is to provide a means of comparison which will indicate the characteristic behavior of these materials under fire-exposure conditions. This is a necessary preliminary step to provide the various regulatory bodies with a fair and equitable means for classifying these textiles and thus protect the consumer from the unsuspected use of excessively flammable materials.

From the standpoint of the fire protection engineer, flammability tests should be designed as far as possible to demonstrate how the material would be expected to perform under "end use" conditions. This is the criteria by which most combustible materials are judged and classified in the many codes and standards relating to fire. Experience in the field of fire research has generally proven that tests developed with undersized specimens and under circumstances which call for the mental mechanics of translation into "end use" conditions are often not significant or representative enough to serve as a good basis of comparison. (Examples: plastics, paints, building code materials.)

Dr Hager thanked Mr Spiegelman for his remarks and stated that any suggestions for using the Variable Angle Tester in the AATCC method must be approved by ECR.

Those in attendance at the meeting were:

C A Sylvester, Vice-chairman; L S Little, Chairman ECR; G R Thompson, Administrative Manager AATCC; M J Babey, Secretary.

R C Allison, E C Atwell, C A Baker, G L Baxter, G S Buck, Jr, H C Chapin, D Chaucer, W E Coughlin, M A Dahlen, H C Donaldson, A E Etchells, M Fishman, F Fortess, E Freedman, R R Frey, N F Getchell, R C Geering, H E Hager, L L Heffner, W A Holst.

R W Jacoby, A E Johnson, P J Kennedy, W Klaas, T Larson, T E Norton, W N Pardy, F J Rizzo, C H A Schmitt, W M Scgall, R B Smith, G M Smith, R H Souther, R L Stutz, A F Tesi, F V Traut, W von Bergen, C O Werner, H E Wilde, J A Woodruff.

RHODE ISLAND SECTION'S "STUDENT NIGHT"

April 22, 1955 — **Univ of Rhode Island, Kingston, R I**

(See meeting report on page P347—May 23rd issue)

(Photos by John E Trezise)

MID-WEST SECTION MEETING

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APRIL 16, 1955

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NETHERLAND PLAZA HOTEL
Cincinnati, Ohio

SEATED AT THE HEAD TABLE——(L to r): Joseph H Jones, Phoenix Dye Works, AATCC vice president; Jack G Kelley, E I du Pont de Nemours & Co, Inc, treasurer; Samuel M Littlejohn, Munsingwear, Inc, vice chairman; Nelson S Knaggs, The Hilton-Davis Chemical Co, evening speaker; Arthur I Hultberg, Bear Brand Hosiery, chairman; Victor C Braun, Jr, recipient of the Section's first Annual Scholarship Award; Harry W Ericson, American Aniline Products, Inc, secretary.

MID-WEST SECTION SCHOLARSHIP AWARD WINNER ——Arthur I Hultberg, Bear Brand Hosiery, chairman of the Mid-West Section (left) congratulates Victor C Braun, Jr, winner of the Section's first Annual Scholarship Award. Mr Braun, of Milwaukee, Wis, has designated Philadelphia Textile Institute as the school of his choice. The Award was made during the evening meeting of the Mid-West Section on April 16th at the Netherland Plaza Hotel in Cincinnati, O.

The Award is an amount not exceeding $400.00 annually. Eligible candidates are sons or daughters of members of the Mid-West Section who are about to enter in one of four years at a recognized textile institute, school or college. The recipient is selected by a committee of Section members appointed each year by the chairman of the Section. The requirements on which the Committee bases its selection are as follows:

Each candidate for the Award will specify to the committee:

a) That he or she is enrolled in or will apply for admission to the textile institute, school or college of his or her choice.

b) The academic standing in the first 3½ years of his or her high school career.

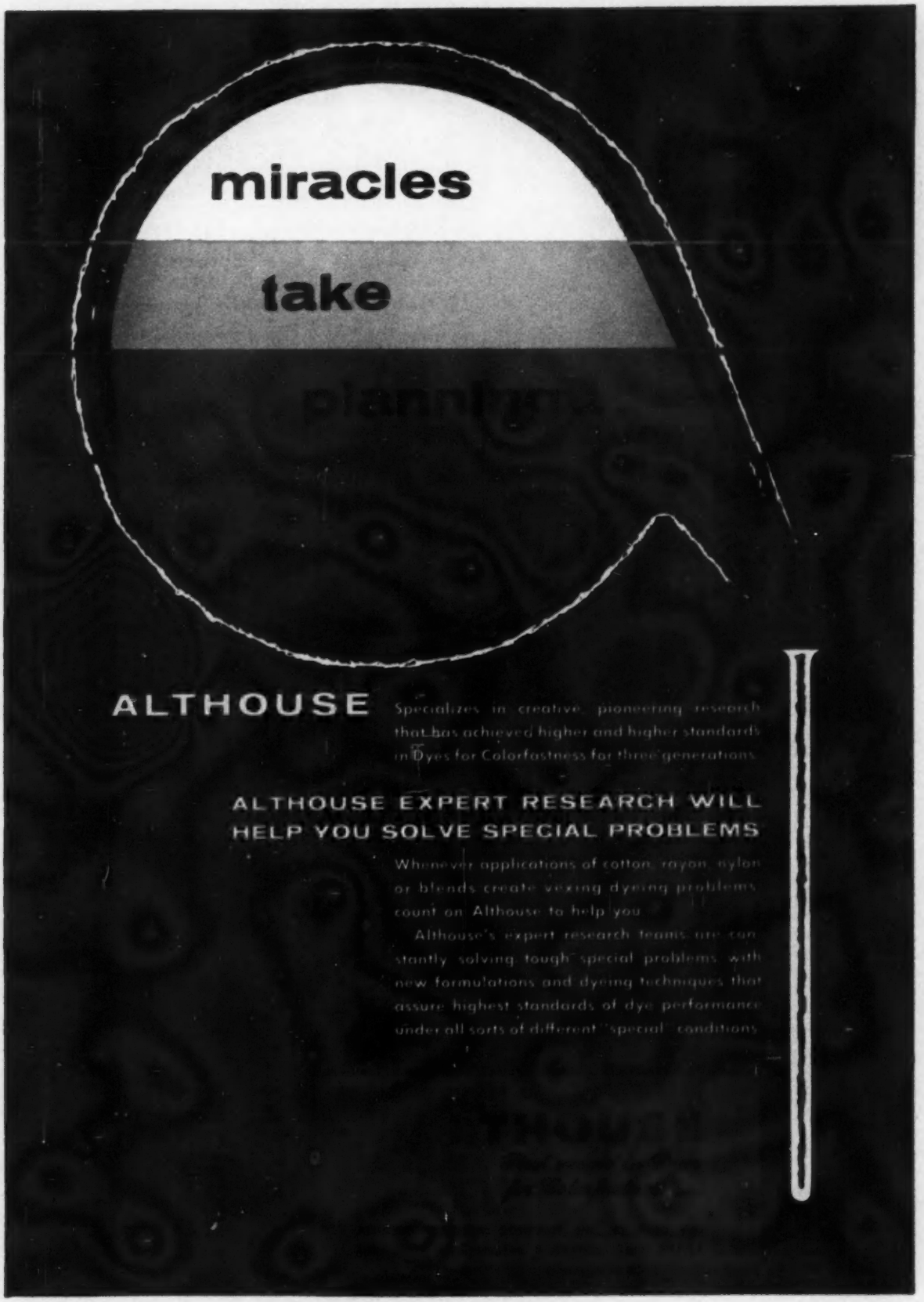
c) Extra-curricular activities during his or her high school or college career.

d) Financial need.

(Clockwise): Mrs Forrest Conrey; Warren B Broadbent, Geigy Dyestuff Div; Rudolph Zwicky, American Art Clay; Jacob Lorch, retired; Victor C Braun, Acme Galvanizing; V W Colby, Emery Industries, Inc; Forrest Conrey, Erie Dyeing and Processing Co.

(Clockwise): Samuel B Wood, Colonial Woolen Co; Robert C Anderson, Cleveland Worsted Mills Co; E R Brunskill; Frank J Myers, Geigy Dyestuffs Div; Harold Durgee; Leonard J Armstrong; George B Chabot, American Cyanamid Co.

(Clockwise): John Nerl, American Aniline Products, Inc; T A Longstroth; Robert Ranier; Don Hertle; R E Dramen; Arthur S Davis, Hilton-Davis Chemical Co; Roy Wallace.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POSITION WANTED: Print Supervisor-Colorist on dress goods, draperies, flannels, table cloths, corduroy, etc. Graduate chemist, fast color-matcher. Will consider steady 2nd shift position and willing to locate anywhere. Write Box No. 896.

WANTED: CHEMIST, to work on plant problems on synthetic piece goods. Metropolitan area. Write Box No. 908.

POSITION WANTED: Dyer-Chemist, desires position with dyestuff, chemical or fiber firm. Extensive plant, laboratory, and managerial experience in box and jig synthetic plants. Textile college graduate. Write Box No. 897.

WANTED: Dyer, for upholstery and automotive piece goods on both synthetics and blends. Pile and flat fabric constructions. Location in the South. Give qualifications and references in detail. Our personnel have been informed of this advertisement. Write Box No. 902.

POSITION WANTED: JIG DYER, 25 years' experience, directs, acetates, nylon and blends. South preferred. Write Box No. 884.

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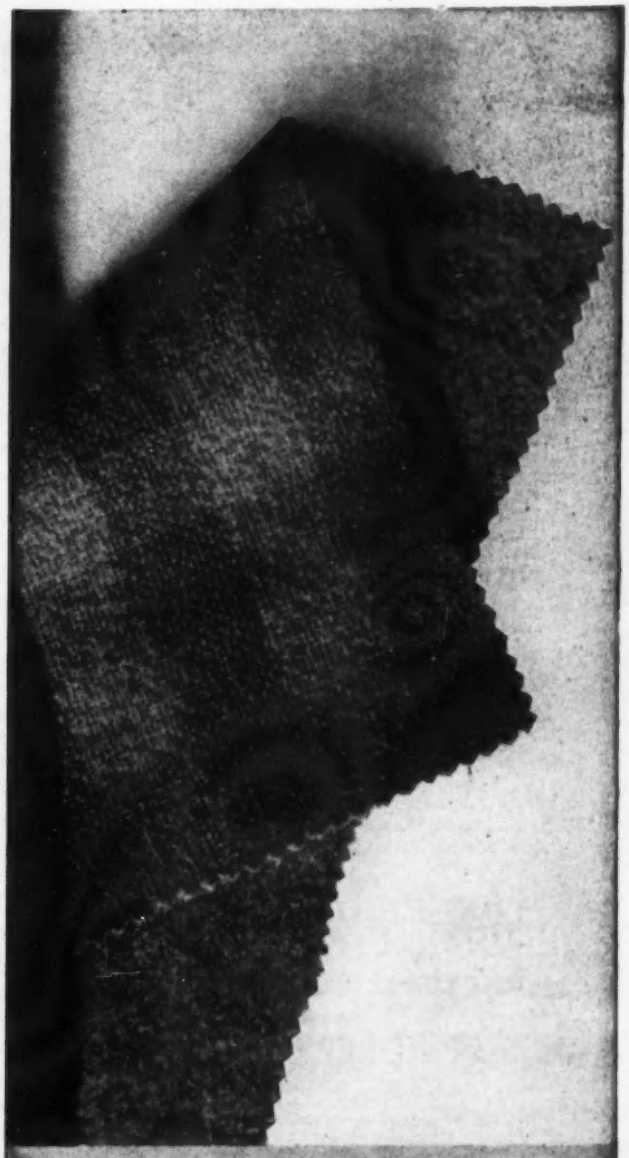

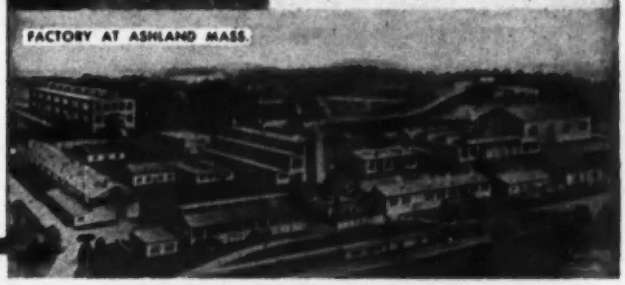

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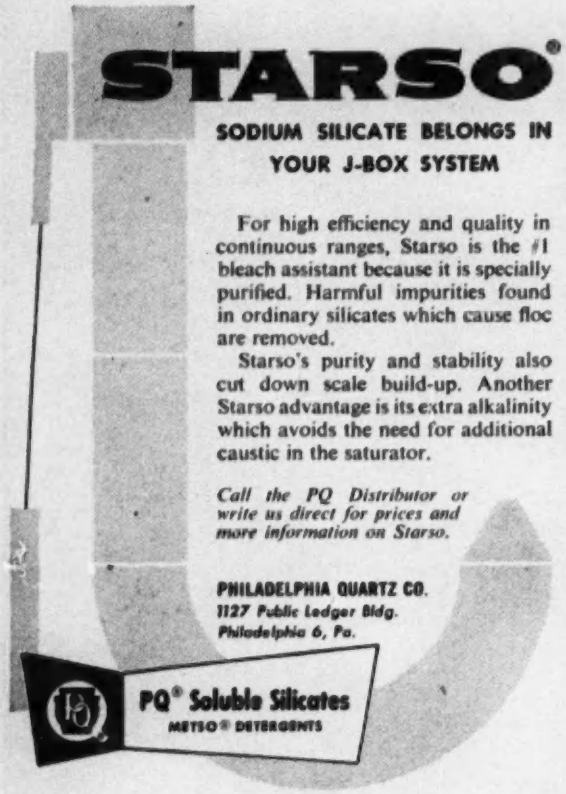
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POSITION WANTED: Textile chemist and supervisor, with thorough background and practical experience, both in laboratory and supervision of dyeing and finishing of natural and synthetic fabrics. Graduate of Lowell Textile Institute. Familiar with processing of all types of fabrics, and use of all types of dyestuffs. Write Box No. 912.

WANTED: Long established N. Y. dyehouse is seeking the following experienced men: (a) Dyer on worsted yarns and piece goods (b) Dyer on synthetic knitted cloth —and sweaters (c) Textile colorists to work in laboratory. In reply state qualifications, age, education and salary expected. Write Box No. 913.

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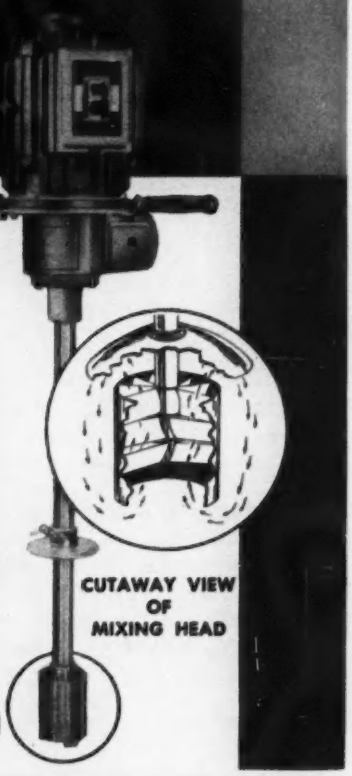

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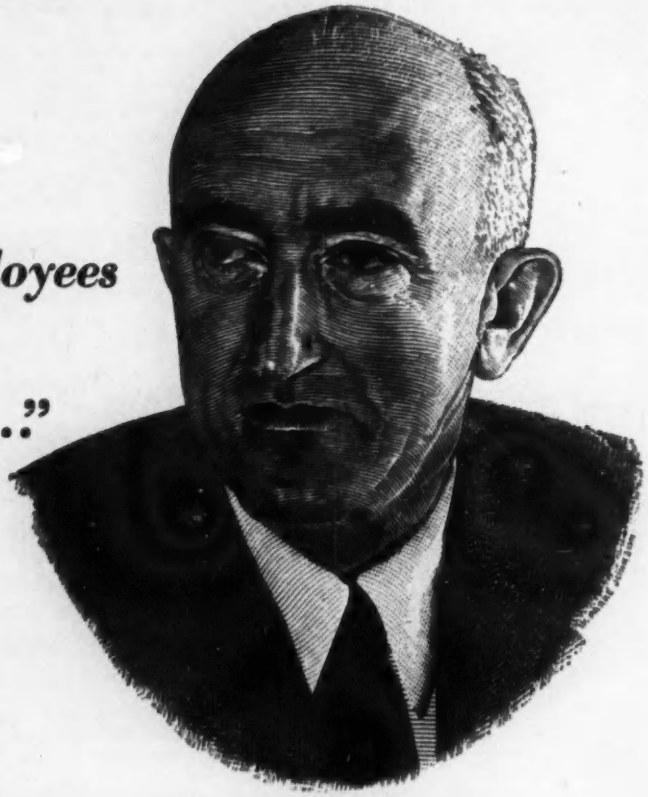

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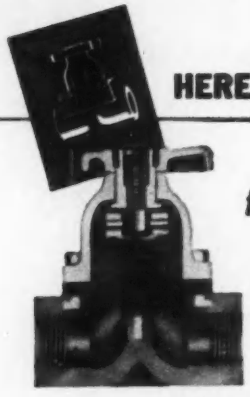

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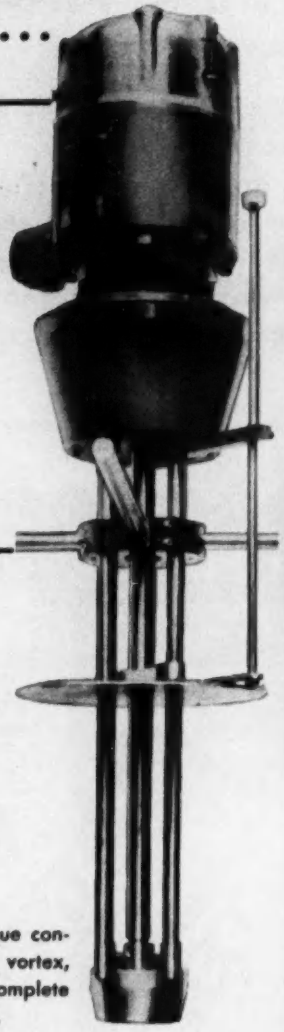

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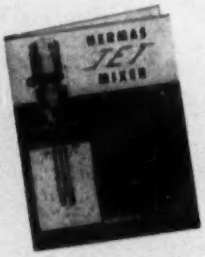

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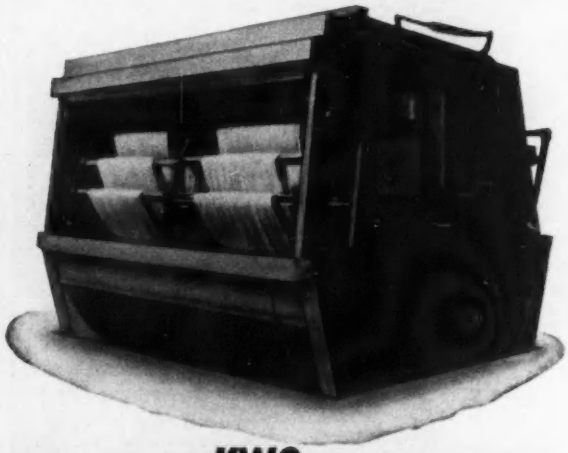

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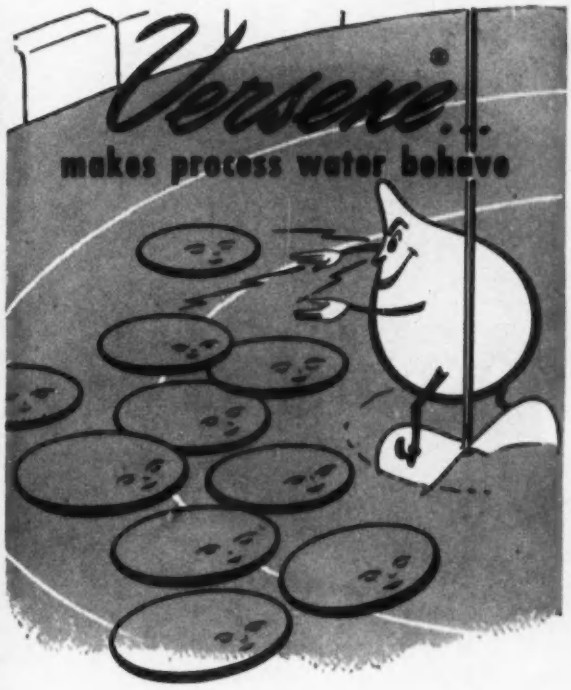

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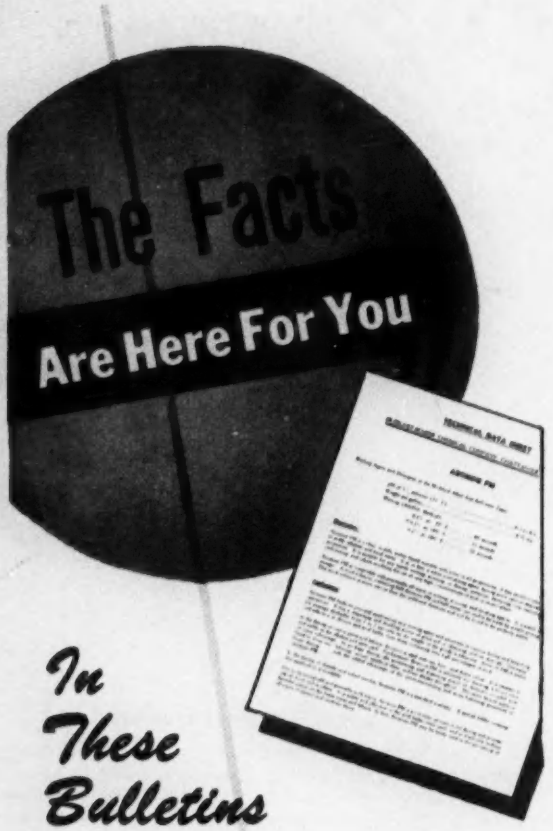

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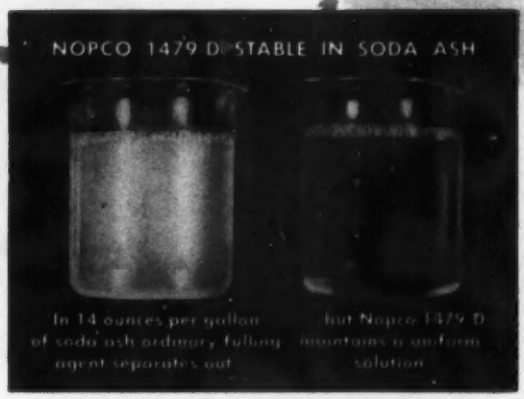
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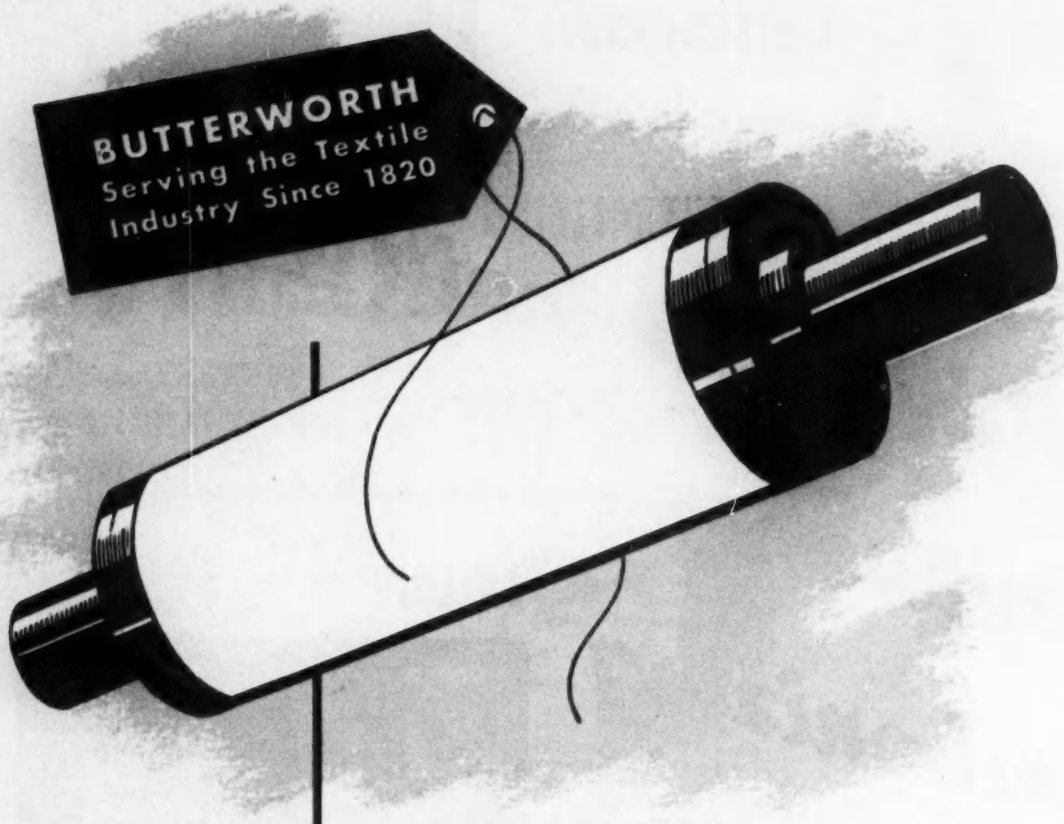

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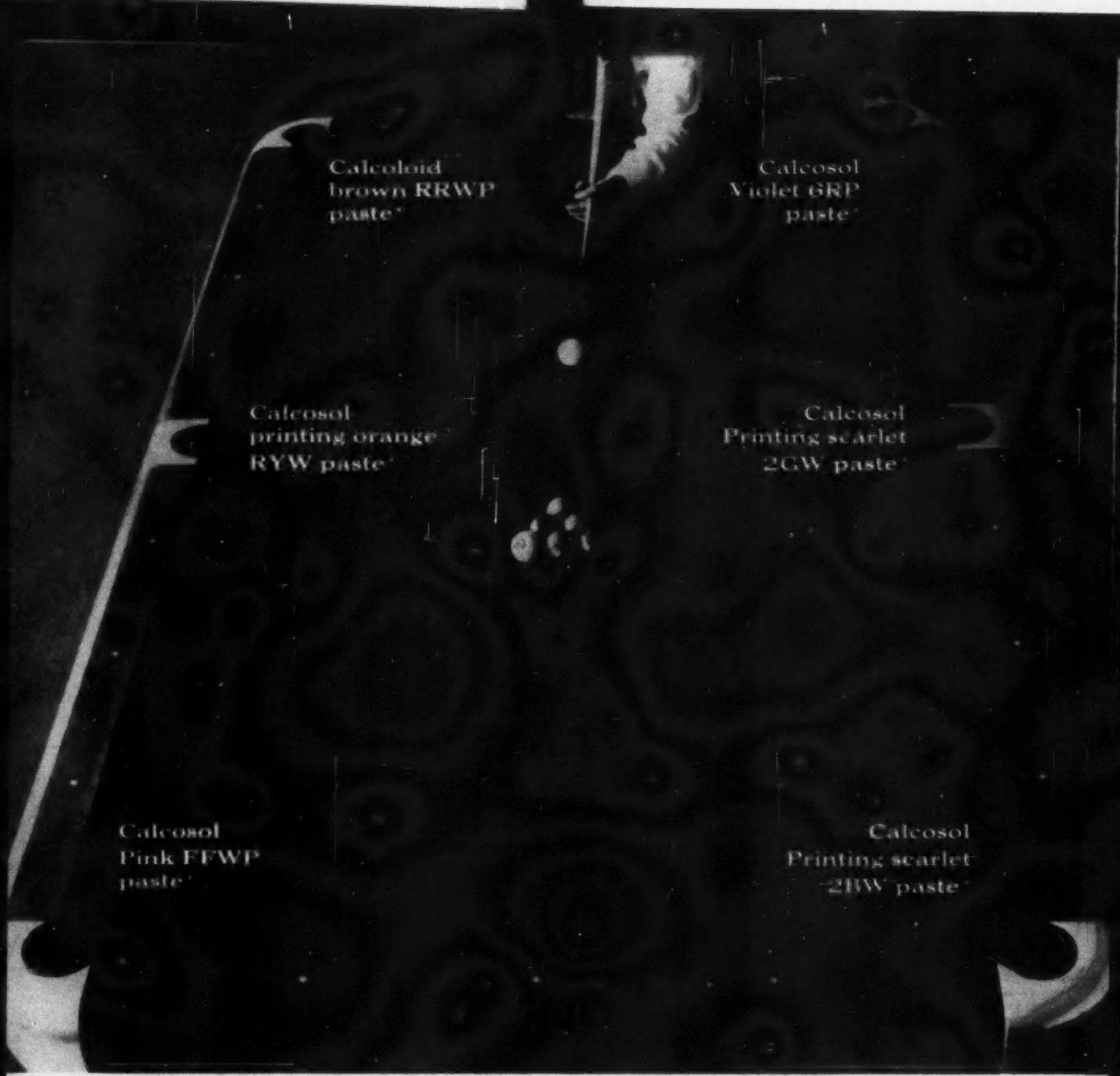
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